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Inland Water Problems

IT is inevitable that in a country of the population and extent of the United States of America, the administration of the various public services should be framed on a scale of greater magnitude and amplitude than is practicable or desirable in smaller countries. Yet even if this be admitted, there is no reason why in any two countries, kindred objects of public concern should not be pursued with equal intensity of effort and corresponding breadth of outlook. Where a service is essential for the general welfare, an equivalent degree of enterprise and energy may not unreasonably be expected in both cases.

This reflection presents itself in considering a comparison of the respective attitudes of the British and American Governments in regard to the question of the national administration of water, one of the most essential services of a civilized community. Until recently, in Great Britain there had been no attempt at the effective co-ordination of water resources of the country on a national and systematic basis, and little control over their exploitation beyond the slight and general supervision of Parliament over Bills relating to powers for local supplies. It was left in rather a vague, haphazard way to the Ministry of Health to take action, if and when necessary, with the result that matters in general were allowed to shape their own course, the Ministry only dealing with specific problems as they arose, a characteristically British method, commonly known as 'muddling through'. As for any definite public statement or programme of policy to be adopted for the most efficient and beneficial use of water supplies in regard to the nation as a whole, serious consideration was rarely given to such matters in official or political circles. Indeed, until forced into action by the pressure brought to bear upon Parliament in consequence of the drought of the years 1933 and 1934, and the joint representation of the British Association and the Institution of Civil Engineers, no attempt at a systematic investigation of the water resources of Great Britain was ever contemplated. Only with some degree of ministerial reluctance, after an unsuccessful attempt to describe it as superfluous and unnecessary, was an Inland Water Survey Committee instituted in 1935 under the Ministry of Health. Since then, there has been appointed, also under the Ministry of Health, a Central Advisory Water Committee, which has been engaged in reviewing the work of nine independent Regional Advisory Committees in various parts of the country. The first report of this Central Committee has just been issued, and it affords an indication of the lack of co-ordination which prevails between these bodies and external interests related to water supply.

In the United States, the subject of inland water control has exercised a far greater degree of Governmental consideration and the matter has been dealt with on broad national lines. There is, in the first place, a National Resources Committee dealing with all the national assets of the country, and an important section of this is the Water Resources Committee, including representatives of the War, Interior, and Agricultural Departments, Public Health Service and Federal Power Commission. Through the activities of this body, a co-ordinated plan and policy for each drainage basin in the country has been laid down, and the individual plans have been reviewed

and co-related in respect of national needs and budgetary limitations. This has been accomplished with the aid of forty-five drainage basin committees, constituted on a democratic basis, with popular representation.

It is pointed out that a unified system of water control, as opposed to a medley of unrelated projects, is essential in the best interests of the nation, and that an integrated federal policy is required in order to deal satisfactorily with various types of water problems having interdependent relationships. The main principles underlying the determination of the adopted programme have been described as a "concern for the promotion of public safety, public health, public convenience and comfort and public economic welfare" so as to secure "the establishment or maintenance of a high standard of living".

Elsewhere in this issue (p. 280) will be found particulars of a six-year programme which has been recommended to Congress, involving in the total an estimated expenditure of 891 million dollars, or a "weighted average" per annum of 200 million dollars—say 40 million pounds. Expenditure on this huge scale indicates profound appreciation of the necessity for a far-reaching development of national resources which, in the case of America, are themselves of enormous magnitude.

The water resources of Great Britain are of much more modest extent, but, none the less, they call for careful conservation and development, and the point may well be raised again, as on a previous occasion (see NATURE, August 4, 1934), whether identification of the Inland Water Survey with the restricted outlook of the Ministry of Health is in the best interests of the country. Water is not the special preserve of any particular Government Department: it is a national asset. We have advocated—and still believe the scheme to be best—the establishment of an entirely untrammelled investigation under the Department of Scientific and Industrial Research, the impartiality and independence of which would secure to the nation at large an unbiased outlook on this matter of national concern. The Ministry of Health has its own problems to face, and is not in any way concerned with industrial or commercial requirements, or with the needs of agriculture, fisheries and navigation. It cannot then be claimed that these interests are adequately represented as they should be in a matter of this kind.

The fact of the existence of the Central Advisory Water Committee does not invalidate our contention in the least. It, too, is a purely departmental Committee and although its functions (*inter alia*) are "to advise the Government Departments on questions relating to the conservation and allocation of water supplies", yet, being under the ægis of the Ministry of Health, it cannot, in our view, have that independence of attitude and breadth of outlook which should characterize a committee of this kind. It is true that it includes among its members, individuals associated with a variety of water interests, but none the less it has to supplement its sources of information with the assistance from other departments of "assessors": one from the Board of Trade, two from the Ministry of Agriculture and Fisheries, one from the Ministry of Transport and one from the Department of Scientific and Industrial Research. If the representations of these assessors are to carry their full weight, the assessors themselves should have the prestige and standing of members of the Committee. The matters with which they deal are not side issues, but questions of serious importance.

We have no intention of making any reflection whatever on the composition of the Inland Water Survey Committee and the Central Advisory Water Committee, or on the particular steps taken by the Ministry of Health to establish them. The cause of criticism lies in the fact that the matter is of such far-reaching importance to all classes of the community that, as in the case of the United States, it calls for the existence of a comprehensive and strictly independent Water Resources Committee on which there would be direct representation of all the varied interests in inland water administration, private as well as corporate. This would naturally include certain Government departments, some of which are remote from the sphere of public health, and relate to the wider aspects of national economy in regard to commerce, transport and industrial development.

A national programme of development drawn up by such an impartial committee would command far greater confidence and support when submitted to Parliament than the unavoidably biased recommendations emanating from a single Ministry. Without such a programme and policy Great Britain must inevitably continue to drift in an aimless way, subject to visitations of drought and flood, and through lack of vision and forethought, reprehensibly neglecting the systematic development of one of the most important natural assets of the country.

Scholiasts and Science

Ancients and Moderns: a Study of the Background of the "Battle of the Books". By Prof. Richard Foster Jones. (Washington University Studies, New Series: Language and Literature, No. 6.) Pp. xi + 358. (St. Louis, Mo.: Washington University, 1936.) 3 dollars.

"Then, *Aristotle*, observing *Bacon* advance with a furious Mien, drew his Bow to the Head, and let fly his Arrow, which mist the valiant *Modern* and went hizzing over his Head; but *Des Cartes* it hit; the Steel Point quickly found a *Defect* in his *Headpiece;* it pierced the Leather and Pasteboard, and went in at his Right Eye. The Torture of the Pain whirled the valiant *Bow-man* round, till Death, like a Star of superior Influence, drew him into his own *Vortex*".

THUS Jonathan Swift, in his satire "The Battle of the Books", written in 1697 to ridicule those of his contemporaries who contended that the performances of their times exceeded those of the ancients. The above passage, and one in which Harvey, Paracelsus and Galen are concerned, are about all that refer to the particular revolt against the ancients that culminated in the foundation of the Royal Society, but nevertheless Prof. Jones gives the subtitle "A Study of the Background of the Battle of the Books" to his book, which is a heavily documented account of the wordy warfare that accompanied the rise of the experimental method in England. It is essentially a history of polemic, and might well itself have appeared under Swift's title, but with Swift's book it has little to do. The title-page may mislead the student of literature.

Prof. Jones is a whole-hearted champion and admirer of Francis Bacon, and attributes the triumph of the experimental philosophy to him alone—"the achievement of this desideratum was the destiny of one man—Sir Francis Bacon". This, and a contention that the Puritans did much to make Bacon's work popular, in connexion with schemes for educational reform, especially the putting down of the teaching of divinity, are his constant theme, in support of which he adduces a large number of authors of various degrees of distinction, or of obscurity; Hakewill, Hartlib, Durie, Starkey, Webster and the like.

Prof. Jones certainly succeeds in proving that between 1640 and 1660 Bacon was often cited as a champion by such men, in their writings against the abuse of classical authority and in favour of educational reform and the utilitarian cultivation of the sciences. None of these men, however, cuts much of a figure as a practical experimenter, or, indeed, as an original investigator of any kind. Prof. Jones is, accordingly, often driven to the type of unsupported assumption that characterizes so many of Francis Bacon's most ardent supporters. He tells us, on the strength of the fact that Wilkins refers to him once or twice, that "Bacon was certainly the chief source of Wilkins' ideas", although Wilkins, in the book in question, set out to expound and defend the Copernican theory, which Bacon ridiculed; Wilkins further adduces Galileo and Kepler, whom Bacon was so far from appreciating that he never refers to either of them. Prof. Jones tells us that "one who has been plausibly identified as Robert Hooke" published a continuation of Bacon's "New Atlantis": he adduces no support of this identification, except that the book is by R. H. Esquire. It is most improbable that it was by Hooke. It was published in 1660, and Aubrey, who was Hooke's great friend, and stayed with him in his lodgings so frequently, tells us that the first thing he published was the known "An Attempt for the Explication of the Phenomena observable in an Experiment published by the Hon. R. Boyle . . .", a little tract which came out under his full name in 1660. Hooke was at the time Robert Boyle's assistant, busily engaged in his beloved experimenting, and it seems unlikely in the highest degree that he should have had the inclination or leisure to publish such a book in the same year, that he should use his initials after having already used his full name, and that he should call himself Esquire—which he was not. In any case, it seems to some of us that the book is completely out of Hooke's character.

As an example of how far Prof. Jones will go, he says, "Though he does not mention Bacon, Worcester is an outstanding example of the hold which the inventive spirit, fostered by Verulam, was fixing on men". There is nothing to show that Bacon had any influence whatever on Worcester—catalogues of inventions, usually illustrated and supplied with detail, were current long before Bacon's influence can possibly have been felt, for example, Ramelli and Zonca, of which traces are to be found in Worcester's booklet—while anyone who has read Worcester's "Century of Inventions" will be hard put to it to find any trace of real inventive achievement in this mere catalogue of projects and devices, many of them clearly impossible and others as clearly never tried,

let alone "perfected", as the author claims for all of them. One example may suffice, "How to make an artificial bird to fly which way and as long as one pleases, by or against wind, sometimes chirping, other times hovering, still tending the way it is designed for". No directions are given as to how any of the inventions are to be constructed. The contention that Worcester invented a practicable steam engine is scarcely taken seriously to-day (see *Trans. Newcomen Soc.*, **13**, 75).

There is one man of science who frequently cites Bacon in terms of warm admiration, namely, Robert Boyle, but even here Prof. Jones gives way to exaggeration. After quoting a large number of citations of Bacon by Boyle he says, "the above are not a tithe of the citations which might be produced". I shall be astonished if Prof. Jones can make this good—at any rate the folio edition of Boyle's work, 1772, has a very good index, and Prof. Jones has cited nearly all the references to Bacon to be there found. Putting aside this hyperbole, however, there is no doubt of Boyle's veneration for Bacon, and a further proof of the respect in which Bacon was held is that his picture appears in the Hollar frontispiece to Sprat's "History" as *Artium Instaurator*. Prof. Jones finds this natural, but then he nowhere considers seriously Bacon's actual achievement, or, in particular, the criticisms of Lasson and Dühring, or of Liebig, Draper and Sir Oliver Lodge, men of science who have carefully considered Bacon's writings.

In spite of his boast that he brought a new method, and of his attacks on Aristotle, Bacon's outlook and terminology were Aristotelian rather than modern. The experimental method which he described, namely, the gathering of vast bodies of observations by journeymen, which were then to be mechanically raked over by a philosophical machine (cf. Prof. Jones's remark: "This democratic spirit is further revealed in his elaboration of Bacon's idea that the [scientific] method requires of its devotees neither learning nor genius"), was incapable of being turned to any practicable use; and, further, he not only had no conception of purposeful experiment or of the working hypothesis, but definitely failed to recognize the scientific work of prime importance that was going on around him. He was a contemporary of Kepler, Galileo, Gilbert and Harvey—Harvey was in fact at one time his "physitian", according to Aubrey —but he has nothing to say of their work, except for a casual condemnation of Gilbert. Harvey's derisive "he writes philosophy like a Lord Chancellor" was justified.

What, then, is the reason that Bacon was so constantly cited by the enlightened amateurs who fought for the experimental method, but, except for Boyle, scarcely at all by the great pioneers who founded modern science. Perhaps it is to be sought in the fact that Bacon, with his great position, furnished that authority for their arguments which was needed by those who had cut themselves loose from Aristotle's authority. A man of Bacon's high office and high reputation was a most valuable symbol of the importance, the respectability of the new experimental learning. He advocated the study of Nature, the devotion of funds to experimental learning and the building of a great foundation for experimental investigation. Those who were working for these things could cite his great name as patron and protector, so that for the controversialists he was a man of the greatest significance. The methods which he advocated, however, and his whole outlook on experimental research, which was purely utilitarian, constituted a retrograde movement rather than an advance, and, confronted with the fact that Galileo and Gilbert had founded modern science, and that Kepler had revolutionized astronomy before Bacon's works were known, it is hard to argue that Newton, Huygens and their great contemporaries would have been one whit the worse, or the advance of science one moment retarded, if Bacon had never lived. For the history of education and opinion Bacon is of great significance; on the history of science as such he exercised, we believe, no influence. Prof. Jones makes no distinction.

Prof. Jones's book is deserving of high praise in that it contains a large amount of valuable material not hitherto brought together, especially that bearing on the hundred years before 1650. He points out that there was a widespread belief during that period that the world was actually in decay, that learning was in its dotage, and that the ancients had laid down limits beyond which we could not hope to progress, and he quotes from various lesser known authors, passages that clearly express that point of view, and describes the campaign which was conducted against it. He also gives a good account of the controversy that attended the birth of the Royal Society, laying stress on the writings of Casaubon, the most enlightened of the defenders of antiquity, and duly describing the writings of Sprat and Glanvill. Of the position of Stubbe, who carried on so sustained and senseless an attack on Glanvill, he does not, however, give a correct picture. Stubbe's "almost insane hatred" of the Royal Society, his "fanatical spirit" and his "intemperate charges" seem to puzzle the author. It has been shown by Dr. Harcourt Brown that Stubbe was merely a hired pamphleteer, "a Man of as much Acrimony as Wit" who "drew his pen with great virulence, and layd about him most furiously indeed and was well gratified by Dr. Hamey for it", Dr. Hamey being

an important figure in the College of Physicians, a body said to have been jealous of the new Society. "It is probable," says Harcourt Brown, "that we do not know more than a very small share of the real motives which involved the Royal Society in such a storm of criticism": the Stubbe incident is one that he happens to have cleared up.

The book is clearly the fruit of long study, and is heavily documented concerning authors of whom little is elsewhere available. It is all the more unfortunate that reference to its riches is made so difficult. Not only is there no index, but also the management of the notes, of which there are some seventy pages at the end of the book, is not a convenient one. Sometimes the title of a book is quoted in the text and reference has to be made to the notes for the author: sometimes the author's name is quoted, and reference has to be made for the book. The numbering of the notes begins afresh for each chapter, so that unless the reader happens to remember the chapter which he is reading, he has to turn back to find it, before he can look up his note. The present reader, at any rate, has found the system very troublesome. He realizes the value of the book, but also realizes that if, in six months' time, he wants to find any particular passage about some remembered name, he may have to search the whole of the book to find it again. A small fraction of the time that must have been spent in gathering the material would have sufficed to digest and order it in such a way as to double its value to the student.

E. N. DA C. A.

Migration of Man: Past, Present and Future

Environment, Race and Migration: Fundamentals of Human Distribution; with Special Sections on Racial Classification and Settlement in Canada and Australia. By Dr. Griffith Taylor. Pp. xv + 483. (Toronto: University of Toronto Press, 1937. 3.50 dollars. London: Oxford University Press. 15*s*. net.)

EVER since the historic controversies of Darwin's days, the evolution of man has been at once the subject of popular appeal and, scientifically, a problem of peculiar difficulty. The layman indulges his fancy in speculating about 'the missing link' and the 'cradle of the race'; the anthropologist often becomes increasingly reticent the more he knows. Which means that anthropology is perhaps still in its 'formative' stage, and knowledge of man, both of prehistoric times and of the present day, is not yet sufficiently advanced for very definite conclusions as to the exact location of the earliest centres of human evolution or the mechanism of the distribution of races.

Prof. Griffith Taylor holds a theory (which he has advocated for a number of years) that there was one 'cradle' of evolution, namely, in Central Asia, and thence spread successive waves of racial stocks—Neanderthal, Negrito, Negroid, Australoid, Mediterranean, Nordic and Alpine. In Parts 1 and 2 of the present work, he elaborates this theory and attempts to survey at once the characteristics and distribution of the different races, the migration routes of primitive man, the climatic and geographic factors at the present day as well as the fluctuations in both these attendant upon Pleistocene glacial and interglacial stages. Truly the author has embarked upon a Herculean task. Anthropologists will not concur in some of his conclusions; but of this he is well aware. He declares in the preface that, since his views on Australia's empty spaces were only accepted after a period of some twenty years, he "hopes that by 1944 his views as to race evolution and the relative status of Nordics and Alpines will be generally accepted!" Points such as these were raised at the time of his earlier publication "Environment and Race" and need not be discussed here.

One could wish that Prof. Griffith Taylor had given space to more details and discussion of racial matters. The book suffers throughout from compression of this material, while some other subjects could well have been omitted (for example, geological features of the world in pre-Tertiary times). The author illustrates his points with numerous maps and diagrams, some of which are most illuminating. He uses the polar projection to indicate the routes of migration from Central Asia; but his description of this map (p. 30) requires revision. It is scarcely correct to speak of a *polar* projection as showing ". . . the central Asiatic land-mass with the three great continental 'peninsulas', America to the south-east, Eur-Africa to the north-east and Australasia to the north-west".

Parts 3 and 4 deal with conditions of settlement in Canada and Australia and with the influence of environment upon potential white settlement. The author is at his best in these sections of the book. Here also, however, the work is too condensed. The part dealing with Canada could well be expanded into a complete geography of the country. Prof. Griffith Taylor discusses the future

of settlement in Canada and estimates that the Dominion could support another ten million settlers. This conclusion is misleading, however, for it is based on figures from the Canada Year Book for 1934–35 for areas of occupied and potential agricultural lands which show a total of occupied land as 163 million acres with 198 million acres still available. It is known in Canada that these figures are a gross exaggeration. He makes a further calculation that the Dominion could conceivably support a population of somewhere about 100 millions. This total is based on population densities in Europe, where, he says, "Geographers are agreed that the population density . . . is almost wholly controlled by crops and coal." He then asks: "How many people can Canada support using the same standards as those of Northern Europe, including the use of coal to the same extent?" The answer which he obtains, namely, 100 millions, is admitted to be a mere approximation and subject to many other factors. Economists in Canada would no doubt have a good deal to say about this. Evidently Prof. Griffith Taylor is ranging himself on the side of the optimists.

The book concludes with a chapter entitled "Deductions and Suggestions", in which the author makes a well-timed plea for the study of anthropology as a means of overcoming national and racial prejudice.

It is difficult to review a work such as this. It contains much that is interesting and stimulating, but it is too rapid in its survey and yet is not free from repetition. Doubtless lack of integration is due in some measure to the incorporation of material previously published in the form of articles, etc. The absence of a bibliography (except for a brief one on Australian settlement) is to be deplored. The serious student will require more detail while for the average reader there is too much, although the author has lighter touches here and there, such as the remark that, of scenery—". . . unlike the human subject, the younger it is the more interesting".

S. W. ALTY.

Evolution of the Printed Herbal

Herbals:
Their Origin and Evolution; a Chapter in the History of Botany, 1470–1670. By Dr. Agnes Arber. A new edition, rewritten and enlarged. Pp. xxiv + 326 + 27 plates. (Cambridge: At the University Press, 1938.) 21s. net.

THE first edition of Dr. Agnes Arber's delightful book on herbals has long been out of print, and the appearance of a new and enlarged edition is therefore doubly welcome. It gives a clear account of the evolution of the printed herbal in Europe between the years 1470 and 1670, primarily from a botanical and secondarily from an artistic point of view. The first chapter deals with the early history of botany, touching on the philosophical treatises of Theophrastus (b. 370 B.C.) and Albertus Magnus (d. A.D. 1280), and the materia medica of Dioscorides, which for sixteen centuries was regarded as the most authoritative work on the subject.

The earliest printed herbals (fifteenth century) form the subject of the second chapter, some of them being in reality far more ancient than their dates of publication would suggest. They include the "Encyclopædia" of Bartholomæus Anglicus, the "Book of Nature" of Konrad von Megenberg, the "Herbarium" of Apuleius Barbarus, the "Latin Herbarius", the "German Herbarius" and the "Ortus Sanitatis". The early history of the herbal in England is discussed in the third chapter, which covers, besides English manuscripts of Apuleius Barbarus, Banckes' "Herball" and the "Grete Herball".

The botanical renaissance of the sixteenth and seventeenth centuries is described in Chapter iv (pp. 52–145), which contains also sections on the "Origin of Herbaria", and the "Revival of Aristotelian Botany". Among the herbals dealt with are those of the German fathers of botany, namely, Brunfels, Bock, Fuchs and Valerius Cordus. No mention is made of the "Botanologicon" of Euricius Cordus (1534), which, though not strictly a herbal, yet affords a vivid picture of the state of botany and pharmacy in Germany in the early sixteenth century, and should be taken into account in any history of the subject. Other sixteenth century botanists whose careers and herbals are reviewed are Dodoens, Clusius and Lobel (Low Countries), Mattioli and Colonna (Italy), Garcia de Orta and Monardes (Spain and Portugal), Gesner and the brothers Bauhin (Switzerland), Turner and Gerard (England).

An all too brief account of the evolution of the art of plant description is given in Chapter v. Here much research remains to be done, especially on the history of botanical morphology and terminology. The sixth chapter outlines the

evolution of plant classification. The evolution of the art of botanical illustration (Chapter vii, pp. 185–246) is treated much more exhaustively, and to the general reader will perhaps be the most attractive portion of the book. It is evidently based on many years of study.

The doctrine of signatures, and astrological botany, are discussed in Chapter viii. The chief exponents of the doctrine were Paracelsus (1493–1541), Porta (fl. 1588) and William Cole (fl. 1657); but it had its origins in remote antiquity, a fact scarcely brought out by the author. In Dioscorides we find, for example, that the "seed" of "Εχιον (*Echium vulgare*) resembled a snake's head and that the root was an antidote for snake-bites.

Dr. Arber points out in conclusion (Chapter ix) the incalculable debt which botany owes to medicine, and a further debt to the arts of printing and wood-engraving, through which the traditional lore recorded in the manuscript herbals was embodied in the printed herbals which succeeded them. In these, the finest period, as regards illustration, was between 1530 and 1614, while classification, nomenclature and description reached their zenith in Gaspard Bauhin's "Prodromos" (1620) and "Pinax" (1623).

There are three appendixes, the first consisting of a chronological list of herbals between 1470 and 1670, the second being a list of historical and critical works consulted, and the third forming a subject index to the second.

Considering the book as a whole, one cannot fail to be impressed by the versatility exhibited by Dr. Arber in dealing with the varied aspects—morphological, taxonomic, historical, bibliographical and æsthetic—of the evolution of the printed herbal. There is only one criticism that may be made, that some account should have been given of the works of the Arab physicians, for example, Serapion, the younger Mesuë, and Avicenna, who are so frequently cited in the "Ortus Sanitatis", and of certain other pharmaceutical works which were much consulted during the fifteenth and early sixteenth centuries, such as the "Luminare maius" of Manlius de Bosco.

The new edition is even more fully illustrated than the first, containing 131 text-figures, 26 plates, and a frontispiece, showing a physician using a herbal, after a picture by Adrian van Ostade (1665). The printing reflects credit on the Cambridge University Press, and both text and figures show up better on the whiter paper employed in this edition. The only misprint noticed is "Isodorus" (pp. 301, 305) for Isidorus. T. A. S.

Chemical Thermodynamics

Physical Chemistry

By Prof. J. N. Brönsted. Translated from the Danish edition (1936) by R. P. Bell. Pp. xv+390. (London: William Heinemann, Ltd., 1937.) Price 12*s.* 6*d.*

IN Prof. Brönsted's book, which has been very well translated and is attractively printed, the bias is towards thermodynamics. Kinetic theory is also treated adequately and is used throughout the book to supplement the thermodynamics. The rather abstract mathematical form of most of the book will tend to make it hard reading for many students. There does not seem to be a single description of an experiment or a piece of apparatus in the book. The thermodynamics is rather unusual, reminding one of Ostwald's 'energetics', with its intensity and capacity factors and the suggestion that the second law can be deduced from the first. This makes the derivation of the fundamental results longer than usual. Once they have been achieved, the thermodynamic laws are applied by Gibbs's method, which the author considers to be the easiest way of attaining simplicity and rigour.

As might be expected, the sections on electrolytes and the general theory of acids and bases are particularly full and interesting. Although activity coefficients are used throughout, the simple Debye-Hückel equation is merely stated without derivation, and its limitations are not emphasized. A rather full treatment is given of the Bohr atom model, but there is no mention of modern quantum theory or even of quantum numbers. Reaction kinetics receive brief but clear treatment, including the author's theory of the intermediate complex, and there is a short account of reaction kinetics in gases from the point of view of critical energy. The section on photochemistry is very brief. A derivation of the phase rule is given, with some very simple examples of its application. A section on surface and colloid chemistry is written mainly from the thermodynamic point of view.

The book will be found very interesting and stimulating by advanced students and by teachers. For honours courses it will require considerable supplementing, and general students will mostly find it rather difficult.

Lectures and Conferences on Mathematical Statistics
Delivered by J. Neyman. Revised and Supplemented by the Author with the editorial assistance of W. Edwards Deming. Pp. ix+160. (Washington: Graduate School of the U.S. Department of Agriculture, 1938.) 1.25 dollars.

IN April 1937, Dr. J. Neyman, of the Department of Statistics, University College, London, delivered three lectures and was the leading speaker at six conferences, all held at the Graduate School of the United States Department of Agriculture, Washington. The lectures were on the theory of probability, on probability and experimentation, and on the testing of statistical hypotheses. The conferences dealt with randomized and systematic arrangements of field experiments, plant breeding, sampling in social problems, analysis of time series, statistical estimation, and confidence intervals.

The conferences were particularly valuable, as those present, many of whom were themselves eminent experts, put searching questions concerning difficult points. In the verbatim reports of these questions and Dr. Neyman's answers, the student will find a discussion of the relative values of alternative methods and of the relationship between alternative theories, which is almost unobtainable elsewhere. The theory of statistical inference seems to be still in a very unsettled state, and the procedure recommended by one authority for conducting, for example, an agricultural experiment, is disapproved of by another authority. Perhaps the differences are not always as serious as they at first appear. Thus Dr. Neyman's theory of confidence intervals cannot, it is insisted, be reconciled with Prof. R. A. Fisher's theory of fiducial probability, but so far the numerical results obtained have been the same, and it is possible that this will always be the case. H. T. H. P.

Diesel Engine Design
By H. F. P. Purday. Fourth edition. Pp. xix+520+4 plates. (London: Constable and Co., Ltd., 1937.) 24*s*. net.

THIS is the fourth edition of a work which first appeared in 1920, and that the fourth edition is called for so soon indicates the value of this book.

A comparison of the new edition with the last gives a very good idea of the progress made in Diesel engine design since 1928, as the author now finds it necessary to include new chapters dealing respectively with supercharging, torsional vibration, structural vibration, lubrication and noise: all these subjects have come into the foreground in that interval.

The title of the book is accurate, since the contents deal more with the art of design than with the sciences of the subject, although this is not to say that the latter are not taken fully into account; each chapter concludes with references to original papers which a reader may consult for a fuller treatment. The reviewer concludes by repeating a remark made in reference to the third edition: "Altogether any criticisms of the book relate only to details, and the author is to be congratulated on having written one of the best books of its kind". S. J. D.

Strahlen um Uns
Von Heinz Tschelnitz. Pp. ii+80. (Brünn, Prag, Leipzig, Wien: Rudolf M. Rohrer, 1938.) 20 Kč.

THIS little book is a survey of the chief questions of what is termed radiobiology. Though it contains a certain amount of controversial matter and not a few speculations, it will interest both physicists and biologists by directing the attention of each to recent researches of the other connected with radioactive and electromagnetic radiations. Evidence is adduced that all living creatures are continually subjected to the influence of such radiations. For example, animals breathe ordinary air which contains radium emanation; their food and drinking water contain a small but definite amount of radioactive salts, and cosmic rays play on them from above. The organs of animals contain minute quantities of radioactive substances.

The author supports the view of Stoklasa that a certain concentration of radioactive elements is natural and proper in any healthy living organism, but that any concentration in excess of this has a pathological effect. He thinks that the relations of radioactivity to life are only just beginning to be understood, and he sees in the further study of the biological action of radiations the likeliest direction of progress in the understanding of life itself. Though the reader may not agree with the author's views concerning the mitogenetic rays of Gurwitsch (cf. NATURE, 119, 556; 1927), the dependence of water divining and cancer on the emission of rays by the earth, and other topics, he will find the speculations entertaining, if not always convincing.

A Course of Pure Mathematics
By Prof. G. H. Hardy. Seventh edition. Pp. xii+498. (Cambridge: At the University Press, 1938.) 12*s*. 6*d*. net.

THE seventh edition of this famous text-book, first published in 1908, has now appeared. It has been revised and reset. The Cambridge Press mathematical printing is better than ever, the spacing and general lay-out of the formulæ being excellent. A large number of new examples from the Mathematical Tripos have been included. The sections on the elementary properties of differential coefficients have been revised, following the treatment in de la Vallée-Poussin's "Cours d'Analyse". Apart from this, the general scheme of the book is unchanged. The author says that the book was written at a time when analysis was neglected in Cambridge, and that if he were to rewrite it now it would be less like "a missionary talking to cannibals" and more like the usual "Traité d'Analyse". No one will regret that he has not made the change. If we all live now on a decent mathematical diet it is due in no small part to the influence of this book. They say that analysis has passed the peak of its popularity; but studies of this kind can never be out of date. We believe that our successors will continue to derive the same inspiration from this book that it has given to us in the past thirty years. E. C. T.

Geological and Archæological Aspects of South-Eastern Asia

By Dr. H. de Terra, P. Teilhard de Chardin and Dr. Hallam L. Movius

MEASURING the age of man in terms of cyclic geological processes has always been a subject fascinating to the student of the Ice Age. Unfortunately, too little is known of such processes outside the glaciated regions to work out a stratigraphic scheme which might be applied to wider regions, and yet this would be the solution to many important problems concerning the Quaternary and the prehistory of man. In Asia, for example, mammalian fossils enable us to distinguish roughly between three Quaternary divisions, but the fossil localities are scattered far and wide, and the Quaternary formations, traditionally passed over by governmental surveys, are very imperfectly known.

The wish to put our knowledge of the Ice Age in southern Asia on a geological basis led three years ago to the joint Yale-Cambridge Expedition to Kashmir and India, the results of which are now in process of publication by the Carnegie Institution of Washington. From these results, the Quaternary of India, was seen to have been determined by diastrophic and climatic events of a very distinct nature, permitting a detailed subdivision of the Ice Age. Its periodic character was expected to make this stratigraphic scheme applicable to neighbouring regions, or to supplement it by additional information. In this way, it was also hoped that the Cenozoic geology of India might become more clearly integrated with that of China, which in turn would aid in the study of Early Man. In discussing this plan with Father Teilhard de Chardin at the occasion of the symposium, held in March 1937 in Philadelphia, we planned to study the late Cenozoic geology and archæology of Burma. Burma, being favourably situated geographically between India and China, held out considerable promise, especially since Palæolithic tools had been found there recently by Mr. T. O. Morris, in association with terraces. A few salient features of the Quaternary of Burma will be briefly outlined below. Father Teilhard de Chardin co-operated with the expedition during the four months of field work, and the third author carried out the archæological work in close association with the geological party.

The expedition was undertaken under the joint auspices of the Academy of Natural Sciences of Philadelphia and the Peabody Museum of Harvard University. Following the field season in Burma, all members of the expedition proceeded to Java. There, during the month of April, we had the opportunity of visiting, under the expert guidance of Dr. von Koenigswald, the sites at which fossil man and Palæolithic implements had been discovered in recent years.

Terrace System of the Irrawaddy Valley

In the Irrawaddy Valley our investigations were carried out chiefly between Magwe and Nyaungoo, near Pagan, but various excursions were made also along tributary streams leading westward to the Arakan Yoma Mountains. The most characteristic features of the Irrawaddy terraces are as follows :

(1) They are superimposed on the 'Irrawaddy Series', a folded and peneplained river formation, the upper part of which contains a mammal fauna analogous to that of the Upper Siwaliks of India.

(2) Occupying an old valley, the terraces are mainly composed of coarse boulder-bearing gravels in which three distinct stages of aggradation could be differentiated.

The highest terrace gravel is preserved in a group of hills, situated in the oilfield of Chauk, and some 350 ft. above the stream. The size of its pebbles depicts an ancestral Irrawaddy much more powerful than the present river. An oldest lateritic soil mantle in the adjoining hills appears to be connected with this stage, which clearly was a period of greater rainfall. (At present this region belongs to the 'dry belt' of Burma, with 60–70 inches of annual rainfall which falls almost entirely between the months of June and September. No lateritic soils are formed here at present.) At one place the highest terrace was found to contain some flaked pebbles of fossil wood and silicified tuff. This terrace is strongly tilted.

The second and third terraces lie some 180 ft. and 100 ft. respectively above river-level, and are associated with a thick series of red gravel and sand. In this was found near Mingun, opposite Mandalay, a Middle Pleistocene type of fauna (with *Elephas namadicus*), and farther downstream an Early Palæolithic industry (see under Archæology). A long interval of erosion and of aridity preceded the deposition of this second river drift, and then a valley was formed with ferrugineous

soil caps containing the earliest prehistoric industry. The second river gravel buried the valley, but prehistoric settlements continued, as indicated by the wealth of rolled Palæolithic tools in the basal gravels. Again this was a period of increased weathering and water supply, during which the adjoining highlands released thick fans of 'red earth' on to the second terrace.

The fourth terrace is made of the third type of gravel, which is generally less coarse and more sandy. A somewhat advanced type of Palæolithic was found in this. The fifth terrace (25 ft.) approaches in composition the recent river deposit, and may be post-Pleistocene in age.

(3) The terraces are associated with soils corresponding to periods of greater and lesser rainfall. The first and second type of gravels are connected with lateritic soils, found on the adjoining land surface. From here 'red earth' was washed into the valley, especially during formation of the second terrace, in which fine-grained red sand merges laterally into lateritic slope-wash deposits. Increasing aridity is indicated by the presence of loessic soils on the fourth terrace. This soil is of yellow or pinkish colour, mostly structureless, and was drifted in the manner of true loess on top of the third terrace the erosional surface of which was thus again buried. The composition of this fourth terrace, however, proves that this must have been a major and prolonged fill stage.

(4) The Irrawaddy terrace system is of regional extent, for it was found also in the adjoining Shan Plateau in the reaches of the Namtu and Salween Rivers.

The interpretation of these features leads to conclusions which are of importance to both geologist and archæologist. It is interesting to note the great resemblance of this terrace system with that found in North-West India, both in respect to the number and the nature of the physiographic cycles. In both regions the terrace formation began in the Middle Pleistocene, because of the then established relative stability in the Himalayan foredeeps in which the Early Pleistocene beds are generally strongly folded. In India, three major fill stages could be correlated with the three last Himalayan glaciations, and terraces were ascertained some 150 miles distant from the limits of glaciation. In Burma, the distance from the glaciated tracts is more than double that amount, but here the soil records indicate the impact of corresponding climatic cycles in the nature of 'Pluvial' and 'Interpluvial' stages, which were apparently superimposed on cyclic diastrophic processes. It is probable that in the upper 'Irrawaddy Series' are hidden two Early Pleistocene sub-stages which as yet do not readily permit of the same detailed analysis. These earlier beds have yielded certain palæontological data which are likely to throw new light on their stratigraphic position.

Palæontological Aspects of the Pleistocene in Burma

The 'Upper Irrawaddy' fauna has been known for some time, especially through studies by Noetling and Pilgrim, and lately Colbert has analysed it anew with the collection of Dr. B. Brown. The vertebrate fossils collected by us can only confirm the view that an 'Upper Siwalik' type of fauna is represented in these beds. In our material, forms such as *Leptobos*, *Bubalus*, *Stegodon*, primitive elephant and horse are most prominent, together with other types of lesser stratigraphic significance.

It is important to note that these beds have for the first time yielded both freshwater molluscs and plant remains. Their state of fossilization, as well as the type of freshwater fauna represented, clearly indicate an Early Pleistocene age for most of the 'Upper Irrawaddy' series. Moreover, the overlying terrace gravels contain a Middle Pleistocene type of fauna (*E. namadicus*, *Bos* cf. *namadicus*, *Hippopotamus*), reminiscent of the Narbada Pleistocene of peninsular India. Such a succession would be difficult to comprehend if the underlying beds were to represent the late Pliocene.

Of special interest was the discovery of fossiliferous fissure deposits in the Shan Plateau near Mogok. Except for a skull of *Ailoropus*, nothing was known of this fauna, which is likely to throw new light on former faunistic relationships of the Indian with the Chinese mammal world. The presence of *Stegodon*, *Elephas namadicus*, *Bos*, *Rhinoceros*, *Cervus*, *Hystrix* links this fauna with that typical for the limestone fissures found in the neighbouring provinces of China.

Correlations with South China

The conclusions arrived at by Teilhard de Chardin in regard to existing analogies between the late Cenozoic of Burma and China can only be mentioned very briefly in this report. Such analogies are striking "mainly (*a*) in the late Pliocene lake deposits of the Shan Plateau; (*b*) in the Early and Middle Pleistocene gravel formations; (*c*) in the fissure deposits. All three are practically continuous between Eastern Burma and the Yangtse basin. They must therefore be contemporary and express the same series of diastrophic and climatic changes over the same geological unit". Hence the terraces of the Yangtse may be linked to those found in India and Burma, and "the possibilities of covering under a single stratigraphic and physiographic scheme the late Cenozoic history of the whole south and central Asiatic Mass becomes an assured possibility".

Archæology of Burma

By Hallam L. Movius

At several localities in Upper Burma, fairly extensive sites yielding Lower Palæolithic tools were discovered. In all cases the implements are rolled and are associated with the main terrace (*T*–3) gravels of the Irrawaddy Valley. This horizon may be assigned on palæontological grounds to the Middle Pleistocene. The principal sites are at Yenangyaung, Chauk and Nyaungoo (near Pagan), although further collecting was also done at Pakokku and at Pauk in the Yaw Valley. The implement types, which include chopping tools, crude scrapers, a few flake implements and cores, are made either of silicified tuff or fossil wood. Hand-axes are completely absent, a fact which seems to indicate a more definite association with an Eastern Asiatic focus than with an Indian one. Typologically, the closest analogies to the Lower Palæolithic of Burma are found at Patjitan in Java, but Dr. von Koenigswald's extensive collection from this latter region includes hand-axes, in addition to an abundance of Burmese forms. Thus at present the cultural affinities of the Burmese Palæolithic are not altogether clear, although the Java connexion cannot be denied. Perhaps both are derived from a common source somewhere in South China, or perhaps in Malaya.

Since an entirely new Lower Palæolithic complex is presented by the Burmese material, it has been named the 'Anyathian' after the coloquial Burmese for an Upper Burman (ān-ya-thā). The early Anyathian is represented by two phases—phase 1 from the basal cemented gravels of *T*–3, and phase 2, which is derived from the overlying uncemented material. Only crude chopping tools, made of roughly tabular blocks of silicified wood, worked on the upper surface of one end, are found in the earliest phase. The implements are all heavily patinated and rolled. In phase 2, however, the forms are more varied: several types of chopping tools, crude flake implements, and nuclei occur. The former include finely made core implements with alternately flaked cutting edges, while the latter are extremely coarse and are devoid of Levalloisean or Clactonian influences. In Burma, therefore, the chopper rather than the hand-axe is the type Lower Palæolithic implement.

The Late Anyathian is found unrolled on the surface of *T*–3 and slightly rolled in the Upper Pleistocene gravels of *T*–4. It seems to be essentially a development from the Early Anyathian, although the implement types are small and on the whole more specialized. They include many new forms — disk-shaped end-scrapers, side-scrapers, blades, and even steep scrapers of Upper Palæolithic type. Chopping tools of the Early Anyathian are also present, which makes it difficult to determine whether this culture represents an innovation or an indigenous development brought under influence from an Upper Palæolithic centre outside the region.

No Mesolithic has yet been found in Burma although the cave region of the Southern Shan States was extensively explored. However, abundant Neolithic material was collected everywhere on the surface of the higher terraces, as well as *in situ*, associated with polished stone axes, at Minbu, and Kyaukpadaung. Pottery from the latter locality confirms the Neolithic dating of this complex, originally described by Noetling as "Eolithic", and more recently by Morris as "Upper Palæolithic".

Thus a chronological basis for the Burmese Stone Age has been established, and as Dr. de Terra points out, this archæological sequence is substantiated by stratigraphy. Burma has, therefore, added another link in our chain of knowledge concerning the development of early man in south-east Asia. One salient fact, however, which emerges from a preliminary study of the Anyathian, is the absence of influence from southern India. This is significant in the light of Dr. von Koenigswald's discoveries in Java, for if the culture of Patjitan is connected with India, traces of this connexion must inevitably exist in Burma. However, with the exception of the Javanese hand-axes, the Patjitanian and the Anyathian are almost identical. These facts, therefore, suggest that we are dealing with a new centre of Lower Palæolithic development in the Far East to which the orthodox European classification cannot be applied.

Excursion to Java

Our field season in Burma closed at the end of March, when all members of the expedition proceeded to Java. Here we visited, under the guidance of Dr. von Koenigswald, the most important places where either fossil man or Old Stone Age cultures had in recent years been discovered. It is impossible to do full justice here to the truly remarkable wealth of information which Java holds in regard to Quaternary geology and early man.

Especially interesting to us was the Solo Valley with its terraces containing Palæolithic industries and the skulls of *Homo neanderthalensis solœnsis* Oppenoorth. One cannot help but feel that a physiographic survey of this region will furnish a key to a more detailed stratigraphy which so far has been founded mainly on palæontological data. Here it became evident that the Quaternary of Java differs in many respects from that found in continental Asia; for one thing, volcanism has here introduced processes of sedimentation the periodic

character of which is not readily recognized. Also, the climatic records of the humid tropics differ altogether from those found in more arid latitudes, and the effect upon fauna and sediments is such as to make direct correlations with the Quaternary of the Asiatic mainland less readily available than was at first anticipated.

The new site of the *Pithecanthropus* skull and mandible near Sangiran, north of Solo, assures beyond doubt the Middle Pleistocene age of this fossil. Its stratigraphic location was in the lower portion of the 'Trinil beds', which are here overlain by some 150 ft. of Middle and Upper Pleistocene fossiliferous strata, all of which are clearly exposed in one section. Especially clear is the position of the infant skull of *Homo modjokertensis* v. Koenigswald, near Modjokerto in eastern Java. Despite the relatively shallow depth at which the skull was discovered (3 ft.), it was evident that in the absence of soils and terraces, nothing could have obscured the true location and stratigraphy of this fossil. Its age, according to von Koenigswald, is Lower Pleistocene because of its association with certain mammals, such as *Hippopotamus antiquus* and *Cervus zwaani*, as appear to be ancestral to others found in the Trinil fauna.

In concluding this report, I wish to express our sincerest appreciation for the financial support which the American Philosophical Society, Harvard University and the Carnegie Institution gave to this undertaking. We also wish to thank the Director of the Geological Survey of India, and the members of the Geological Department of Burma and our colleagues in Java for the friendly co-operation extended to us.

International Committee on Social Relations of Science

THE Committee on Science and its Social Relations (C.S.S.R.), instituted by the International Council of Scientific Unions, in May of last year, held its second meeting in Paris this year, when a number of organizational questions connected with the work undertaken were discussed. From a report prepared by the secretary the following points may be mentioned:

As stated already (NATURE, 140, 983; 1937. 141, 723; 1938), the main work of the C.S.S.R. for the present is to collect materials for the preparation of a report and of bibliographies on the social relations of science, to be presented at the next meeting of the International Council in 1940, and thereafter, it is hoped, to be printed for wide circulation. For the execution of this plan, the C.S.S.R. has applied to the national academies, or other nationally representative bodies of various countries, and to a number of international scientific organizations, with the request to assist it in its task by supplying information, and by appointing correspondents who may gather around themselves other men of science interested in the work of the C.S.S.R., so as to form local or special groups co-operating with the latter. The Royal Society of London has nominated Prof. F. E. Weiss as its correspondent, and a subcommittee, with members for physics, chemistry, engineering and, if possible, also for medicine and for some other branches of science, is being formed.

To guide correspondents in furnishing their communications to the C.S.S.R., it was proposed to draw up questionnaires, indicating the points which should be judged to come within the scope of the inquiry. The preparation of these questionnaires was a kind of experiment, as in a way they should form a programme for analysing the manifold influences that science and human society exert upon each other. Various points of view presented themselves, according to which topics might be classified; on one hand, attention should be given to the influence on social relations emanating from the application of a number of definite recent scientific discoveries; on the other, the influence of science on the outlook of men and women should be considered. The relation between certain subjects and the life of human society further could be investigated according to national points of view, or from that of the various domains of science themselves.

It was decided, therefore, in the first place to draw up a 'general questionnaire', intended as a guide for the use of correspondents of the nationally representative scientific organizations of the various countries. The subjects listed in this questionnaire have been grouped under three headings, as follows: (1) the meaning of scientific research for the development of our world picture—to be understood not only in the philosophical sense, but also in the sense of the set of ideas with which the public (in its various forms of appearance) is operating; (2) the influence of the applications of scientific work upon human society, the transformations that are induced by them and the adaptations which are required in consequence; (3) reactions of human society upon scientific work.

In connexion with the experimental character of the work, it may very well appear that other subjects besides those listed will have to be introduced, or that various questions should be framed

differently. It must be remarked also that, owing to the structure of the International Council, in which the medical and engineering sciences, agriculture, sociology and economics have no representation, problems referring to the latter subjects provisionally have been left aside, the more so as these subjects require a different treatment and should not be attacked before some experience and contact with the organizations specially created for them might have been obtained. Only a few 'borderland' problems have been touched upon here and there.

In asking the national correspondents to give attention to the 'general questionnaire', it is not expected that they should treat all the subjects listed in full. The extent to which information can be supplied will depend upon the measure in which attention is given to science in the various countries, and thus may largely differ from one country to another. It is possible also that certain questions may not be directly applicable to the conditions found in some countries. It has been suggested that correspondents leave aside questions which appear to them to bear no relevance to the situation in their countries, and either restrict themselves to the other questions or give information in a more independent form.

It should be emphasized, however, that the C.S.S.R. hopes to receive information concerning the many points of view which may be developing in various countries. Along with the list of questions for national correspondents, a series of questionnaires has been drawn up in which the subjects are considered from the points of view of the particular branches of science. These questionnaires are not intended for consideration by the national correspondents, but are forwarded to correspondents of international scientific organizations. In part they contain some of the same topics as had been brought together in the 'general questionnaire', but for a number of subjects more detailed problems have been noted. These questionnaires thus far have been devised for: mathematics, astronomy, mechanics, physics, chemistry, biology, geophysical sciences, geography.

The C.S.S.R. has also requested correspondents to supply a bibliography or a list concerning summarizing and reviewing or abstracting work that is being done with respect to scientific publications, either in their country (in the case of national correspondents) or in the branch of science represented by them (in the case of correspondents from scientific organizations). Such lists should give the names of progress reports, collections of abstracts of scientific literature, names of abstracting and reviewing organizations, science press service where this is present, etc.

The C.S.S.R. hopes that along with the help given by correspondents and their sub-committees, co-operation may be obtained and organized with other bodies occupied with similar problems.

At the present moment there seems to be a possibility of coming into contact with the British Association for the Advancement of Science—at the forthcoming Cambridge meeting the Council of the British Association will present a scheme for the establishment of a special Division for the social and international relations of science (see NATURE, July 30, p. 195); and with the American Association for the Advancement of Science.

Attempts are being made to secure the foundation of an organization for the study of the social relations of science also in Holland. Such organizations, which should be formally wholly independent of the C.S.S.R., can perform much useful work by promoting special investigations on problems of importance for the country where they are working, for which purpose—assuming that the necessary financial means can be found—'research students', for example, might be appointed. At the same time they could assist the correspondent of the C.S.S.R. in his work of collecting information according to the general questionnaire, while, on the other hand, the C.S.S.R. can help in establishing international contacts, and in correlating results brought forward from different countries. Moreover, such organizations may find the possibility of considering sociological and economic problems, which fall outside the scope of the I.C.S.U. and the C.S.S.R.

It is expected, finally, that assistance also may be obtained from individual scientific investigators who take an interest in the work of the C.S.S.R. Apart from the help that may be asked from them with reference to particular scientific topics, there are the following points concerning which views or information often can be given better by individual persons than by official organizations:

(*a*) The part played by scientific thought in the outlook of various social groups.

(*b*) The forms in which scientific workers and their work are involved in the various struggles and conflicts of human society.

(*c*) The forms in which the consciousness of a social responsibility of science and of scientific workers is taking shape.

Scientific workers who desire to give information or to express views on points coming under the scope of the Committee's work, are requested to communicate with the correspondent for their country or their branch of science, or directly with the secretary of the C.S.S.R. (Prof. J. M. Burgers, van Houtenstraat 1, Delft). The secretary of the C.S.S.R. also will be glad, upon application, to forward copies of the report or of the questionnaires to persons interested.

Water Development Schemes in the United States*

THE National Resources Committee of the United States Government, the membership of which includes the Secretaries for the Interior, for War, for Agriculture, for Commerce and for Labour, has issued an important document on "Drainage Basin Problems and Programs (1937 Revision)", which has been prepared by the Water Resources Committee with the co-operation of local, State, regional and federated organizations. It is a comprehensive review of suggestions emanating from forty-five Drainage Basin Committees, themselves nominated by "Governors and State Planning Boards, including field men from interested Federal bureaus". It will thus be seen that the recommendations are based on a widespread representation of national interests.

The report was commissioned by the President and constitutes a revision of the report to Congress on February 3, 1937, rendered necessary by recent developments, including fresh problems and new standards of treatment. An amended programme, accordingly, has been prepared, covering a series of specific projects to be undertaken within a 2–6 year period, at an estimated cost, amounting in the total to 891,091,000 dollars, with a "weighted average" per year of 200,624,000 dollars. This weighted annual average compares with more than 180,000,000 dollars recommended in the President's 1939 Budget for the same classes of work. During the last six years, the Federal Government has expended more than 1,300,000,000 dollars on works of a similar character.

Foremost in the report comes the subject of flood control, which in the United States is a matter of the most serious public concern. One has only to recall the devastation and loss of life caused during the floods of recent years in the Mississippi and Ohio river valleys to realize how vital this matter is to a vast mass of the population. Unfortunately, the problems involved are so complex that, as yet, they are inadequately explored, and it is felt that it would be most unwise to authorize any additional general flood control plan until more trustworthy information is obtained. An early inauguration of surveys and investigational studies of a comprehensive character is urged and budgeted for at a cost exceeding 260 million dollars.

The reclamation for agricultural purposes of extensive regions of arid and semi-arid country requires continued attention. Works are already authorized and in hand to the extent of upwards of 600,000,000 dollars, but further surveys are needed for future planning and development. West of the 100th meridian, there is a vast domain of no fewer than 700 million acres where agriculture can make no progress without artificial irrigation. The outlay required is put at nearly 300 million dollars. Problems of flood control policy naturally involve a consideration of the allocation of cost among the various scattered communities in low-lying regions subject to inundation, in fair proportion to the incidence of benefit and of ability to pay, and this is a matter which can only be settled by prolonged negotiation.

Water-power is an important consideration in the United States, where there are very considerable reserves ready for exploitation. The energy produced is utilized in many directions for power, heating and lighting. Water-power has within the past half century furnished 3–4 per cent of the total energy derived alike from mineral fuel and water, and the report states that "despite the fact that the nation now depends and in future must depend largely on its fuel resources, its water power is of great value and presents great opportunities in the co-ordinated development of water resources". Some of the more important undertakings in hand, as the Boulder Dam on the Colorado River, the Bonneville and Grand Coulee Dams on the Columbia River, and the series of developments in the Tennessee Valley have already been described in NATURE (**139**, 738, 823, 986; 1937.)

The other subjects dealt with in the report, which runs to more than 150 pages, are so many and so varied that it is not practicable to touch upon them all within restricted limits of space. A mere enumeration shows that they include navigation, soil conservation, beach erosion control, projects for agriculture and grazing, pollution, recreation and wild-life, hydrological data and investigations, and multiple-purpose projects.

The report concludes with an expression of the conviction of its members that "a National Planning Agency should have as one of its chief duties the continuous development of broad plans for full use of our water resources in relation to human needs and social objectives". This clear and explicit declaration of policy might with advantage be adopted in other countries, and every credit is due to the United States for setting so conspicuous an example of enterprise in the exploitation of its own supplies.

*Drainage Basin Problems and Programs, 1937 Revision. (National Resources Committee, Washington, D.C.) Pp. x+154+4 plates. (Washington: Gov. Printing Office, 1938.) 65 cents.

Obituary Notices

Dr. J. W. Mellor, C.B.E., F.R.S.

ON May 24, science suffered a great loss by the death of Joseph William Mellor, a man of remarkable attainments and outstanding achievement.

Born at Huddersfield in 1869, Mellor was taken by his parents to New Zealand when ten years old. During his youth he worked in a boot factory and took classes in the evenings at the Dunedin Technical College. At the age of twenty-five years he was awarded a scholarship at the University of Otago. After graduating and serving as a science lecturer at an agricultural college he was awarded an 1851 Exhibition, which took him to the University of Manchester in 1899. Under H. B. Dixon, for whom he had the highest regard, he completed a number of researches, perhaps the most important being investigations into the combination of hydrogen and chlorine.

On leaving Manchester, Mellor went to North Staffordshire, and, after a short period as science master at the Newcastle (Staffs.) High School, began his long association with the ceramic industries on his appointment as lecturer in pottery manufacture in Stoke-on-Trent.

At the commencement of his career in ceramics, Mellor worked under some difficulties, and it was due, in no small measure, to his initiative that the present North Staffordshire Technical College was built in 1914. He was appointed the first principal of the Pottery Department. As a teacher he was very popular with his students, and, in this capacity alone, he rendered great service to the local pottery industry. There can be no doubt that his early struggles gave him a deep insight into the difficulties of his evening students. Shortly before his death he said, "I think that I spent some of the happiest years of my life with those early students".

Mellor's great friendship with Bernard Moore, the eminent potter, played a conspicuous part in the progress of clay technology in Great Britain. He was associated with the work of the Ceramic Society about three years after its formation, becoming honorary secretary in 1905, a position he held until his death. He raised the status of the Society from a purely local association to that of an international institution. He extended its field to include refractory materials and clay building materials, as well as pottery. The Society's present eminence is a lasting testimony to his high endeavour.

Mellor wrote more than a hundred papers on ceramics, the first in 1904 and the last he completed two months before his death. Covering a very wide field, his researches into the constitution of the clay molecule and the properties of glazes are, perhaps, the most important. His papers on "The Crazing and Peeling of Glazes" and "The Durability of Pottery Frits, Glazes, Glasses and Enamels in Service" appeared in 1935 and gained world-wide appreciation. He was quick to realize the importance of refractory materials to the well-being of an industrial nation. He made contact with the manufacturers and users of these products, and, in 1909, was closely associated with the formation of the Refractories Committee of the Institution of Gas Engineers, which has been responsible, in Great Britain, for pioneer work into the properties of refractory materials. This association developed, and, in 1919, Mellor was largely instrumental in establishing the British Refractories Research Association under the ægis of the Department of Scientific and Industrial Research. As its first director of research, a position he held until 1937, he enlisted and retained the support of manufacturers and users of refractory materials, added great distinction to the work of the Association, and founded "The Mellor Laboratories", the present headquarters.

To his great scientific attainments, Mellor added a singular literary ability. 1937 saw the completion of his monumental work, "A Comprehensive Treatise on Theoretical and Inorganic Chemistry" in sixteen volumes. He received, during his lifetime, unstinted praise for this remarkable effort. To his few intimate associates, the completion of these volumes is almost beyond comprehension. They know that he wrote every word and every reference.

As a student, Mellor found it impossible to follow the many developments in chemistry without a good working knowledge of higher mathematics. His habit of making full notes of all his difficulties led him to consider writing a book on the application of higher mathematics to chemistry. Putting the suggestion to H. B. Dixon, he was advised to convert his ideas into words, and thus, in 1902, his first book, "Higher Mathematics for Students of Chemistry and Physics", appeared. Shortly afterwards he set to work on his "Chemical Statics and Dynamics", which was published in 1904, and later he confessed that the writing of this book had given him very great pleasure. His "Modern Inorganic Chemistry", a book of distinct individuality, had a remarkable vogue in the whole of the English-speaking world and rightly so. As a result of his early work in ceramics, in 1912 he completed "A Treatise on Quantitative Inorganic Analysis", which remains a standard work on silicate analysis.

In his youth, Mellor had considerable physical strength, and was a powerful swimmer. He was an enthusiastic and highly accomplished chess player. His sense of humour delighted all who knew him, and he combined with this considerable ability as a cartoonist. His book of cartoons, "Uncle Joe's Nonsense", revealed his ever-youthful spirit.

Mellor was a man of indomitable courage, profound wisdom and experience. He had remarkable astuteness. Of his pertinacity and capacity for sustained exertion there is abundant evidence. He could pursue a preconceived course of action with a tenacity of

purpose rarely achieved. He had a vivid appreciation of loyalty and friendship. To those who knew him, his supreme loyalty was, indeed, his greatest attribute. He was respected by all and much more than respected by those who were privileged to know him intimately. A. T. G.

Dr. W. C. Willoughby

WE regret to record the death of the Rev. Dr. W. C. Willoughby, an authority on the Bantu of South Africa, who died at Birmingham on June 19 at the age of eighty-one years.

William Charles Willoughby was born on March 16, 1857. He was the son of Richard Willoughby of Redruth, Cornwall, and was educated at Tiverton and Springhill College, Birmingham. In 1882, having been ordained a Congregational minister, he joined the Central African Mission of the London Missionary Society, but was compelled to return home after twelve months service owing to ill-health. His interest in Africa, however, continued unabated, and in 1893 he was appointed by the London Missionary Society to deal with difficulties which had arisen at Phalapye, the headquarters of Khama, paramount chief of the Bechuana. After the Matabele War he was chosen by Khama and the two chiefs, Bathoen and Sebele, to act as their adviser in their appeal to the British Government in relation to the proposal to hand over the Bechuanaland Protectorate to the Chartered Company. Largely owing to his efforts their appeal, presented by them in person in London, was successful.

Willoughby remained in Bechuanaland for eight years and was then selected to act as first principal of the Tiger Kloof Educational Institution, which he had founded near Vryburg, Bechuanaland. Here he instituted a very successful scheme of training in industry, craftsmanship and teaching for young African men and women. Willoughby retired from Tiger Kloof in 1917, and two years later was appointed professor of African missions in the Kennedy School of Missions, Hartford, Connecticut. He held this chair until 1931, when he retired, receiving the honour of D.D. Dr. Willoughby was widely recognized as an authority on Bantu anthropology. He was a member of the African Races Committee from 1900 until 1908, and had been a local correspondent of the Royal Anthropological Institute since 1905. He was the author of "Native Life on the Transvaal Border" (1900), "The Soul of the Bantu" (1928), and "Race Problems in the New Africa" (1923). In these he showed a sympathetic insight into the mental qualities of the South African native, and though fully alive to the desirability of developing native culture, recognized the danger of attempting to impose Western civilization on native tradition.

Dr. L. Lilienfeld

LEON LILIENFELD, whose death occurred quite unexpectedly at Milan on June 6 through pneumonia contracted whilst engaged on the industrial application of his latest inventions, commenced his professional career as a medical man. A growing interest in cellulose led him to abandon medicine and devote himself to research work on this material. In 1912 he produced new derivatives of cellulose, namely, various cellulose ethers having very widely different properties and capable of diverse applications. The Great War interrupted these activities and Lilienfeld was engaged on X-ray work in the Austrian army. He wrote a book embodying all his experiences which even to-day is regarded as a standard work in this branch of medical research.

After the War, Lilienfeld returned to his work on cellulose and evolved a process by which viscose can be spun into a thread having a tenacity far greater than that of any rayon thread known at that time. Naturally, this work brought Lilienfeld into prominence not only with the rayon world but also far beyond. Afterwards he returned to the field of cellulose ethers, which he perfected in their application to rayon, films, etc. In this connexion it is interesting to note that Lilienfeld showed that certain ethers when taken internally counteract the effects of alcohol.

Much of the work of Lilienfeld is embodied in numerous patent specifications, which demonstrate with what extraordinary energy and thoroughness he pursued his investigations.

Those who knew Lilienfeld will learn of his death with deep regret, and many have lost in him a friend of great charm and generosity.

Rev. E. Burrows, S.J.

WE regret to record the death of the Rev. Father Eric Burrows, Assyriologist and cuneiform scholar, who was killed in a motor accident near Oxford on June 23. Educated at Felstead and Keble College, Oxford, Eric Burrows joined the Order of Jesuits in 1915. He studied Assyriology under the late Prof. S. P. Langdon, specializing in cuneiform epigraphy, and had already established a reputation as an authority upon the early religious and legendary literature of Mesopotamia, when in 1936 he became attached to the staff of Sir Leonard Woolley as epigraphist in the excavations at Ur. He worked with the Ur expedition in the field in each successive season until 1930. Much of his work is still unpublished; but his contributions to the official volumes on "The Royal Tombs" dealing with the documents of the early dynastic period of Ur, and his "Archaic Tests" are accepted as the standards of reference on archaic palæography and the beginnings of cuneiform.

WE regret to announce the following deaths:

Prof. G. W. Cavanaugh, emeritus professor of chemistry in Cornell University, on July 2, aged sixty-eight years.

Capt. F. S. Barnwell, O.B.E., chief designer of the Bristol Aeroplane Company, a pioneer in British aviation, on August 2, aged fifty-eight years.

Prof. L. Frobenius, who led numerous expeditions to different parts of Africa, and was a great authority on African culture, aged sixty-five years.

News and Views

Geology and Archæology in South-Eastern Asia

In another column of this issue of NATURE (see p. 275) there appears a communication from Dr. H. de Terra, Dr. H. L. Movius and Father Teilhard de Chardin of far-reaching significance for the study of early man in Eastern Asia. The investigations of the joint Yale-Cambridge expedition to northern India, of which Dr. de Terra was leader, having established by the examination of the quaternary deposits a detailed subdivision of the Ice Age in that region, it was hoped that a like investigation of the quaternary gravels of the Irrawaddy Valley, in view of their central situation, might afford evidence for the integration of the cenozoic geology of southern China with that of India. Inferentially, it is obvious, such an integration would be of crucial value in establishing the chronological relation of the evidences of early man in the two regions. In 1937 an expedition under the joint auspices of the Academy of Sciences of Philadelphia and the Peabody Museum of Harvard University, with Dr. de Terra again as leader, entered upon the investigation of the quaternary deposits of the Irrawaddy. Not only was the expedition successful in establishing the resemblance of the Irrawaddy terrace system with that found in north-west India, while the soil records indicate the impact of corresponding climatic cycles, apparently superimposed on cyclic diastrophic processes, but it was also able, thanks to the co-operation of P. Teilhard de Chardin, the distinguished authority on the quaternary geology of China, to demonstrate as sufficiently assured the possibility that the late cenozoic history of the whole of the south-central Asiatic mass will be covered ultimately by a single stratigraphic and physiographic scheme. At the same time the subsequent visit of the expedition to Java made evident that the quaternary of that area differs in many respects from that of the mainland and that direct correlation will be less readily available there than was anticipated.

THE palæontological evidence is of special interest in relation to the development of recent theory in the Chinese field. The most significant feature is the discovery of a previously unknown fauna in the fissure deposits of the Shan plateau, which, it is said, may prove to throw light on former faunistic relationships of the Indian with the Chinese mammal world. This fauna of the Shan plateau is linked with that typical of the limestone fissures of the neighbouring provinces of China, which figures prominently in P. Teilhard de Chardin's recent researches. The archæological evidence, as Dr. Movius shows, is no less important. It presents an entirely new lower palæolithic cultural complex, for which the name "Anyathan" is proposed. In this culture the type lower palæolithic implement is the chopper, rather than the hand-axe. It persists into late Anyathan side by side with many new and more specialized forms, making it difficult to decide whether this culture is to be regarded as an innovation, or an indigenous development under outside influence. It is especially to be noted, however, that although a chronological basis for the Burmese stone age has been established, substantiated by stratigraphy, and Burma thus affords another link in our chain of knowledge concerning early man in south-east Asia, the really striking fact which emerges is the absence of influence from southern India. There is, however, except in one respect, close resemblance with the recently discovered Patjitanian of Java. These facts, Dr. Movius concludes, are such as to suggest that we are dealing with a new centre of development in the Far East, to which the orthodox European classification cannot be applied.

Composite Aircraft Development

THE seaplane upper part of the Short-Mayo composite aircraft has flown the return journey across the Atlantic. It was able to get off the water from the American side under its own power, owing to the much smaller load of fuel required for the west to east journey with its constant following winds. Now that the success of the idea is established, plans are in hand for a new design on similar principles incorporating all the modern developments in aerodynamics, such as constant speed airscrews, retractable undercarriage, slots and flaps as aids to lift and control, etc. The body will probably be arranged principally for mails, with a few passengers.

ANOTHER composite aircraft of somewhat different principles is proposed by Mr. A. Plesman, of the K.L.M. Royal Dutch Air Lines. The lower component in this case is practically a flying undercarriage that can make contact as well as detach itself while the upper main machine is in the air. Thus in normal flying the aircraft will have no undercarriage, saving the consequent weight and drag. This proposal is essentially different to the Short-Mayo design, in that it does not add the extra wing area and engine power for the take-off when the machine is heavily loaded with fuel and oil at the commencement of a long flight. Launching by catapult, or some such form of acceleration, is proposed to deal with this difficulty. The scheme presupposes no necessity for any unexpected forced landing en route, a not unfair assumption with modern engine reliability, and the use of multiple-engined machines. In any event, a successful landing on the sea, in the case of a trans-ocean flight, would be of little value, as an average aircraft would be too fragile to remain afloat long under any but the most ideal of conditions.

New Cooling System for Aero-Engines

MESSRS. ROLLS ROYCE have introduced a new system of water cooling under pressure on their "Merlin IV" engine. This is similar to the usual atmospheric one, but is closed and provided with loaded valves, so that the boiling point of the water under pressure is raised. The many recent developments in metallurgy and lubricating oils have made it possible for the internal combustion engine to function at higher temperatures, and thus to increase thermal efficiency, in addition to the obvious advantage of using smaller radiators with both less drag and weight. The more general method up to the present of maintaining the engine at the higher temperature permissible has been to use liquids with higher boiling points. Ethylene glycol is the most generally used in Great Britain, but this has objections in its corrosive effect upon parts of the cooling system, especially the inevitable joints, if a substance such as a rubber or leather compound is used. Extra cost, and the necessity of carrying a supply of the special liquid, are also points against such preparations. The new radiator and cooling system fittings may need to be somewhat more robust for dealing with pressure, but this is not altogether a disadvantage in that the more solid construction will add to its reliability. Weakness due to flimsy construction has often been typical of the older water cooling systems. It is reported that these engines with their new cooling will be fitted to the Armstrong Whitworth "Whitley" the new R.A.F. bomber, now coming into production.

British Speleological Association

AT the third annual conference of the British Speleological Association, which opened at Giggleswick School, Yorks, on July 30, Dr. R. R. Marett, rector of Exeter College, Oxford, was elected president in succession to Sir Arthur Keith, who has held that office since the foundation of the Association. As an anthropologist Dr. Marett is perhaps best known for his studies of the religion and psychology of primitive peoples, but his connexion with the archæological exploration of caves is of long standing. In 1911 he described before Section H of the British Association the excavations in the cave in St. Brelade's Bay, Jersey, carried out by himself and other members of the Société Jersiaise, which resulted in the important discovery of a tooth of Neanderthal man in association with Mousterian implements.

THE conference of the Speleological Association was declared open in an original and appropriate ceremonial by Mr. J. A. Slingsby, chairman of the Governors of Giggleswick School. At a business meeting of the Association it was reported that the survey of underground waters in Yorkshire, Derbyshire and Somersetshire is being continued, and that considerable progress had been made in listing the caves of Britain in which archæological material had been found in the past. In addition to papers presented for discussion at sectional meetings, the proceedings included visits to a number of museums in Settle and neighbourhood containing material illustrating and recording the results of cave exploration, and visits to the caves themselves, including the Victoria and Jubilee caves, long well known for their archæological importance, and Gaping Ghyll on Ingleborough, with its 340 ft. shaft, miles of passages and huge main chamber. On the evening of August 1, Sir Arthur Smith Woodward addressed the Association on "Wild Animals Living with Early Man in Britain". The Association will meet next year at Swansea.

Roman Site in Wiltshire

AN impressive indication of the general diffusion of a high degree of refinement in mode of life in Roman Britain, and also of the economic and social decadence which accompanied the decay of Roman rule, is afforded by the remains of a villa recently discovered at Atworth in Wiltshire (*The Times*, August 6). It is indeed remarkable that traces of a building of such an extent as has been revealed in the excavations of 1937–38 should have evaded previous record. Its existence was made known only through the discovery by a schoolboy in a cornfield of a coin afterwards identified as of Constantine I. This led to an investigation, which was begun in August 1937 and at once revealed courses of masonry, in some instances no more than six inches below the ploughed surface, now known to have been part of an L-shaped house of 'corridor' type, containing at least twenty-four rooms or passages, a suite of baths, four or possibly five hypocaust chambers, a flight of six stone steps, and three rather inferior tesselated floors. Evidence that either on this site, or in the immediate neighbourhood, there had stood a building of considerable architectural pretensions was found in the form of fragments of stone used to support a floor in one of the hypocausts, which were well worked and showed good mouldings. They had once formed part of a cornice or plinth of a building in classic style. The house was roofed with purplish pointed tiles of sandstone from the neighbourhood of Bristol. Many rooms show evidence of conflagration in the form of a black deposit, mostly charcoal, above the floor, in which are broken tiles and roof nails. In places three occupation levels can be seen, and sometimes the highest immediately above the burnt deposit is a primitive floor of rough flat stone or irregularly fitted pieces of roof-tile. Series of bronze coins range from Gallienus (A.D. 253–268) to Valens (A.D. 364–378); while the pottery can be ascribed to the second, third and fourth centuries A.D. It is thought that the villa may have been partially destroyed by fire in the raids of Picts, Scots, Franks and Saxons in A.D. 367, when many villas in south and western Britain were abandoned, to be occupied later, when the raiders had been driven out, by lower class Romano-Britons.

Prehistory and the Sahara

A MEETING of the International Commission for Study of the Prehistory of the Sahara, which was initiated by Prof. P. Rivet, and of which Sir Robert

Mond is president, was held in Paris on June 27–30. It was attended by a number of distinguished archæologists and others interested in the problems of the Sahara from France, Great Britain, Egypt, Italy, Tunis, Morocco and the Sudan. Numerous important communications, illustrated by lantern slides and exhibits, were presented and discussed in the sessions of the Commission. For the first time it was possible for the quaternary problem in the Sahara to be discussed as a whole, without reference to irrelevant political boundaries. Special stress, it would appear from a brief report in the *Journal des Débats* of July 4, was laid on the geological and geographical unity of the Sahara as a whole from the Nile to the Atlantic, in which the conditions of development, of desiccation, and of life are subject to the same general laws, notwithstanding certain local divergences. Valuable comparisons of observations from west, centre and east were made, and various conclusions emerged. Among these, that from the early palæolithic onward it was not possible to establish exact correspondence between Africa and Europe, and secondly that the succession of the large number of rock engravings and paintings in the Sahara continued down to modern times. The Commission, it will be seen, has thus made a substantial beginning in the important work of synthesis in Saharan studies. The results will appear in a volume, of which the publication has been guaranteed by Sir Robert Mond, who also entertained the members at luncheon at the close of the proceedings. It has been decided that the Commission will meet every fourth year, the business of the Commission in the interval being conducted by Mr. Harper Kelley at the Musée de l'Homme, Paris.

The Czechoslovak Research Council

DURING the twenty years of the existence of the Czechoslovak Republic, the university authorities and scientific institutions of that country have not failed to realize the importance of research work in the natural sciences. Among the organizations which have fostered academic investigations is the Czechoslovak National Research Council (Československá Národní Rada Badatelská). This body has just issued its fourteenth annual report, in which reference is made to the work recently published and still in progress. Practically all branches of science are represented, and some of the investigations have been commented upon already in NATURE. From the report, too, it is learnt that several prominent Czechoslovak men of science have been invited abroad to describe their special contributions to recent advances in the different sciences. On the other hand, students from various European and American countries have spent some time in the laboratories at Prague and Brno, studying technique in chemistry (polarographic methods), archæology (excavations in Moravia), biology and physics. During the year under review the Council, together with other bodies, arranged for the International Congress for the History of Science which coincided with celebrations of the hundred and fiftieth anniversary of the birth of J. E. Purkyně, the physiologist. The report also refers to the support the National Research Council has given to some fifty students (fourteen of whom were thus able to go abroad), which has permitted certain investigations to be undertaken or prolonged. These include special geological surveys, archæological excavations, a study of certain properties of heavy water, work on genetics, the ecology of certain lake flora, and biochemical examinations of fungal colonies in beech woods.

The Rhodes Scholarships

THE Rhodes Scholarships statement for 1936–37 shows a distribution of the 185 scholars (93 from the British Empire overseas, 86 from the United States and 6 from Germany), as follows: natural science 56, philosophy, politics and economics ('Modern Greats') 36, law 29, modern history 17, English 14, Litt. Hum. 10, economics 8, mathematics 6, modern languages 3, geography, education and colonial service probationers 2 each. The particulars given of distinctions achieved by former Rhodes scholars are interesting for the light they throw on the question how far the founder's objects are being realized. Every one of the fourteen Americans is described as holding an important position (such as head of, or professor in, a university or college, or member of congress) in America, which accords well with the words in Rhodes's will: "without, I hope, withdrawing them or their sympathies from the land of their adoption or birth". As regards the British Empire (the retention of the unity of which was one of the declared objects of the scholarships) noteworthy appointments mentioned are those of governor of the Canadian Broadcasting Company, solicitor to the Treasury, Ottawa, chancellor of the University of Sydney, director of education, Victoria, director of the Institute of Pathology, Sydney, and Nuffield professor of surgery, Oxford. One of the Germans is professor of economics and political science, University of Heidelberg, and another president of the Academy of Sciences, Munich. "The object", says the will, of the German scholarships, "is that an understanding between the three Great Powers will render war impossible and educational relations make the strongest tie".

Canadian Research Scholarships

FORTY-NINE scholarships have been awarded for 1938–39 by the National Research Council of Canada. Graduates from fourteen Canadian universities have been given awards which will enable them to pursue post-graduate studies at the following universities: Dalhousie, Laval, McGill, Montreal, Queen's, Saskatchewan and Toronto. Four special scholarships will be tenable in the National Research Laboratories at Ottawa, where the holders, who have already gained post-graduate experience in research, will be given an opportunity to put their talents to work on some practical problem such as they may expect to meet when they enter commercial or

industrial work. For work in the universities, the scholarships granted include one fellowship, seventeen studentships and twenty-seven bursaries. Twenty-eight of the awards are to be used in financing graduate students in chemistry, including fourteen in physical chemistry, six in cellulose research, four in organic chemistry, two in general chemistry, one in inorganic chemistry and one on a practical chemical problem in the National Research Laboratories. Twelve candidates will work in physics, including three in the National Research Laboratories. Other divisions of science represented in the awards are: biochemistry, 2; biology, 2; botany, 1; entomology, 1; genetics, 2; and mathematics, 1.

Rockefeller Travelling Fellowships in Medicine

THE following Rockefeller travelling fellowships in medicine have been awarded by the Medical Research Council for the academic year 1938–39: R. R. Bomford, assistant physician, London Hospital; T. Colver, outpatient medical registrar, Hospital for Sick Children, Great Ormond Street, London; R. M. Heggie, assistant lecturer in pathology and bacteriology, Welsh National School of Medicine, Cardiff; Ian MacKenzie, assistant surgeon, St. Giles's Hospital, London; Dr. G. G. E. Smyth, Dickinson research scholar, National Hospital, Queen Square, London; Ivor G. Williams, senior assistant radiotherapist, Meyerstein Institute of Radiotherapy, Middlesex Hospital. All these fellows propose to work at centres in the United States, with the exception of Dr. Smyth, who intends to study in Paris. Dr. Williams will hold his fellowship for six months only. In addition, the Rockefeller Foundation has awarded similar fellowships, on the recommendation of the Medical Research Council, to the following candidates in the special field of psychiatry, neurology and related subjects, all of whom are from the Maudsley Hospital, London: T. R. C. Fraser, W. W. Sargant, and M. J. F. McArdle.

The World Power Conference

WE have received from the Central Office of the World Power Conference, Kingsway, London, the annual report for 1937. Dr. William F. Durand is the president and Sir Harold Hartley is the chairman of the International Executive Council. The first conference was held in London in 1924, the second in Berlin in 1930 and the third in Washington in 1936. In addition, six other special meetings have been held. The next meeting of the council will take place in Vienna on August 29, 1938. The total number of National Committees of the World Power Conference is now 42, and in addition there are four member-countries with representatives. After the conference at Vienna this year there will be a study-tour of about a week's duration. The Central Office continues to circulate to the National Committees and representatives, reports on the work being carried on by the International Special Committee on Radio Interference, under the auspices of the International Electrotechnical Commission.

THE following appointments of official delegates to the sectional meeting of the World Power Conference to be held in Vienna on August 25–September 2, have been made: to represent the Government of the United Kingdom, Sir Harold Hartley (chairman, International Executive Council and chairman, British National Committee of the World Power Conference, and Mr. J. M. Kennedy, deputy-chairman, Electricity Commission; appointed by the British National Committee of the World Power Conference, Sir Archibald Page, chairman, Central Electricity Board, and Dr. F. S. Sinnatt, director of fuel research, Department of Scientific and Industrial Research. The total attendance from the United Kingdom will exceed eighty, which is a record for any sectional meeting of the World Power Conference held abroad.

International Management Congress

STRONG British support has been secured for the seventh International Management Congress which meets in Washington, D.C., on September 19–24. More than ninety delegates, fully representative of British industry, are attending to support Lord Leverhulme, who is the president of the International Committee. An interesting unit of this party consists of nine young executives, one of whom is a lady, who are being assisted by bursaries paid out of the funds remaining from the sixth International Congress held in 1935 in London. This party will travel together as a unit under the leadership of Dr. E. F. Armstrong: it is anticipated that each will profit from the collective experience of the whole. Four tours by motor coach have been organized, enabling the delegates to visit a number of factories and cities. Before the Congress, there is one tour of six days in New England and a second, taking five days, to the highly industrialized country between New York and Washington. After the Congress, an eleven-day tour goes through the mid-West to Chicago and back to New York via Buffalo and Niagara, and there is a final short tour to Boston. It is proposed to give some form of written report of the visits, which will serve as a permanent record. The tours are likely to be of exceptional educational value from the point of view of scientific management. About 250 papers from some twenty countries have been accepted by the Congress. The papers of each technical section have been summarized. The chairman of the Congress Council is Mr. Willis H. Booth, vice-president of the Guaranty Trust Company; that of the Co-ordinating Committee is Mr. William L. Batt, president of S. K. F. Industries; whilst the chairman of the Organizing Committee is Mr. Harry A. Hopf, well known as one of the most active protagonists of the management movement. The delegates will be welcomed by Mr. Cordell Hull, and there will be a formal reception at the White House.

International Scientific Radio Union

THE sixth General Assembly of the International Scientific Radio Union (Union Radio Scientifique Internationale) will be held in Italy on September 4–14. The U.R.S.I. is one of the constituent bodies

of the International Council of Scientific Unions, with its secretariat in Brussels; and it is concerned with the various scientific aspects of radio communication and radio physics, in many branches of which international discussion and co-operation is beneficial in stimulating both theoretical and experimental research. At the previous general assembly of the U.R.S.I. held in London in 1934, Prof. E. V. Appleton was elected president, and he is also chairman of the British National Committee, of which Dr. E. H. Rayner is secretary. Other members of this committee who will be attending the forthcoming meeting in Italy include Prof. S. Chapman, Mr. T. E. Eckersley, Mr. E. B. Moullin, Mr. J. A. Ratcliffe, Dr. R. L. Smith-Rose and Mr. R. A. Watson Watt. It is anticipated that representatives of some twelve or more other nations will also be in attendance. The work of the General Assembly is divided among five commissions dealing respectively with radio measurements and standards, the propagation of waves, atmospherics, liaison and radio physics. The opening meeting will take place on September 4 at Venice, where most of the business of the Assembly will be carried out during the ensuing week. The formal closing meeting takes place in Rome, and various technical visits and other appropriate engagements of interest are included in the programme.

Imperial Veterinary Conference

An Imperial Veterinary Conference will be held at the Royal Veterinary College, Camden Town, London, N.W.1, on August 15–19. The subjects to be discussed will include the work of the Imperial Bureau of Animal Health, foot-and-mouth disease and certain other virus diseases, Johne's disease, bovine mastitis, caseous lymphadenitis of sheep, sheep blowflies, fowl paralysis and chronic bovine hæmaturia.

Announcements

The Jenner Medal of the Royal Society of Medicine, which is awarded for distinguished work in epidemiological research or for pre-eminence in the prevention and control of epidemic disease, was presented to Sir Arthur Newsholme on July 19.

The *Queen Mary* has established a new record for the east to west crossing of the Atlantic. She berthed at New York on August 8, after having covered the distance from the Bishop Rock to the Ambrose Channel lightship in 3 days 21 hours 48 minutes, at an average speed of 30·99 knots.

It is announced by the Berlin correspondent of *The Times* that a new height record for a glider was set up at Wasserkuppe by Capt. Walther Drechsel on August 5, when he ascended to 23,190 ft. The machine, a Minimoa glider, was towed to a height of about 3000 ft. and then released.

Through the generosity of the late Mr. Herbert Harlow of Bradford, the Bradford Technical College has been able to establish a Harlow fellowship of the value of £250 a year for research to be carried out at the Technical College, Bradford, in one of the branches of science relating to the textile industry or the dyeing industry. Mr. R. Williamson has been appointed to the first fellowship.

An Advisory Committee on Blindness, including its prevention and treatment, has recently been formed by the Minister of Health. The following have been appointed members of the Committee: Dr. P. M. Evans (chairman), H. R. Bickerton, J. D. Magor Cardell, Miss Grace Cracknall, James Ferguson, Percy Fleming, N. Bishop Harman, Dr. E. K. Macdonald, Miss Ida Mann, R. Foster Moore, G. F. Mowatt, Sir John Parsons and A. H. H. Sinclair. The Committee has been appointed for a period of three years. Mr. H. G. Benjamin, of the Ministry of Health, will be secretary, and Dr. A. E. Hallinan, of the Ministry of Health, will be medical secretary of the Committee.

The following awards for 1938–39 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company. Fellowships have been renewed in the case of Messrs. A. J. Shorter (to the University of Illinois), J. L. Tuck (at the University of Oxford) and to S. H. Wade (at Imperial College, London). Fellowships have been awarded to H. D. Anderson (University of Oxford), A. Cameron (Imperial College, London), H. S. Corran (University of Cambridge) and R. N. Haward (University of Cambridge). The Salters' Institute has also awarded fifty grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

The following appointments and promotion have been made in the Colonial Service: H. C. Thorpe to be plant breeder, Kenya; M. H. C. Glyn, to be veterinary officer, Northern Rhodesia; W. G. G. Pevie, to be veterinary officer, Tanganyika Territory; D. A. Frye, to be assistant analyst, Analyst's Department, Straits Settlements; J. R. E. Hindson (agricultural superintendent, Gold Coast), to be agricultural officer, Northern Rhodesia; R. M. Nattrass (plant pathologist, Cyprus), to be senior plant pathologist, Kenya; Gunn Lay Teik (assistant analyst), to be chemist, Department of Agriculture, Federated Malay States; W. Molegode (officer of Class I, Grade I, Agricultural Department), to be agricultural officer (Propaganda), Ceylon.

Dr. Wendell Meredith Stanley, of the Rockefeller Institute, Princeton, has been awarded the Rosenberger Medal of the University of Chicago in recognition of his isolation of crystalline forms of the filtrable viruses. The Rosenberger Medal for distinguished achievement in the advancement of learning or for notably great service in the promotion of human welfare has been awarded five times previously.

The first International Congress for Forensic and Social Medicine will be held at Bonn on September 22–24 under the presidency of Prof. Pietrusky, director of the Bonn Institute of Forensic Medicine. Further information can be obtained from Prof. Schrader, Franzosenweg 1, Halle a.d.S.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 296.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Fundamental Physical Concepts

THE flux-cutting equations, $H' = [VJ] = \varepsilon[VE]$ and $E' = -[VB] = -\mu[VH]$, enunciated in my article in NATURE of February 5, in conjunction with the ionic constitution of matter and the simple physical treatment of electric wave propagation, have suggested some novel physical concepts which may help towards at least a partial reconciliation between the classical and modern theories.

The classical theory was based on macroscopic experiments and hence dealt almost exclusively with average or resultant forces and fields; but if an attractive force or bond exists between every proton and electron, these straight bonds constitute the actual lines of force, and our familiar 'lines of force' are really only imaginary lines which indicate the direction of the resultant force and have no physical existence. An 'uncharged' body, that is, one containing equal numbers of protons and electrons, certainly produces no external resultant field, but on this view it has two similar systems of bonds radiating from its protons and electrons respectively, so that it should be regarded as being surrounded by two equal and opposite electric fields; and since an electric current consists of a procession or stream of electrons or protons or of both travelling in opposite senses, a linear current must be surrounded by two opposed radial electric fields moving translationally past each other. Since $H = [VJ] = jVJ \sin\theta$, and $J = e/r^2$ at a distance r from a charge e, $H = jev \sin\theta/r^2 = jids \sin\theta/r^2$, so that these moving electric fields are equivalent to a magnetic field and no vertical concept of a magnetic field appears to be called for.

The attractive force or tension in the bond between a proton and electron of charge $\pm e$ respectively is of course $T = e^2/\varepsilon r^2$, and the electrokinetic or 'magnetic' energy of a transversely moving electric field shows that the bond has an equivalent mass of $m = \mu e^2/r^2$ per unit length. But the velocity of propagation of transverse disturbances along a cord under a tension T and having a mass m per unit length is $V = \sqrt{\frac{T}{m}}$, so that for the above values of T and m, V should be $1/\sqrt{\varepsilon\mu}$. This indicates that transverse electric disturbances travel along the bonds exactly as if these bonds were material fibres or contractile tentacular projections from the protons and electrons, and enables the field distribution round a dipole oscillator to be determined with great simplicity. Incidentally, the total mass of the bonds surrounding a spherical charge e of radius r_0 works out to Sir Joseph Thomson's value of $2\mu e^2/3r_0$ for the electromagnetic mass associated with the charge.

In dielectric media the bonds between the molecules are loaded with ions which are also cross-coupled by the intra-molecular bonds, and the passage of an electric disturbance produces transverse displacements of the positive and negative ions in opposite senses, which are opposed by the inter- and intra-molecular bonds. This modifies the velocity of propagation and makes it dependent on the wavelength, in accordance with the Drude dispersion theory. If the medium moves, its internal bonds which correspond to Fresnel's 'bound ether' move with it, while the bonds which connect external charges and correspond to his 'free ether' do not; and this provides a simple explanation of the Fresnel drag coefficient.

Although this material bond hypothesis offers no explanation of the repulsion between like charges, except the pressure which must result from the attractive forces, it provides a very simple picture of the processes involved in electric wave propagation which is in complete agreement with the Maxwellian theory; and since the bonds appear to have mass they may be slightly curved or deflected by transverse gravitational as well as by electric fields, which may explain the deflection of light passing near the sun, and gives a simple physical interpretation of the relativistic 'curvature of space'. Moreover, although the bonds from a single orbital electron must oscillate and transmit radiation, those from a close assembly of such electrons will evidently interfere and transmit little or no radiation; while sporadic and more widely separated disturbances caused by changes of orbit would be transmitted with little interference. This conforms, at least qualitatively, with the Quantum theory; and if we assume that the violent ejection of electrons is accompanied by high frequency oscillations of their shape and bonds, the Heisenberg wave electron and electron diffraction phenomena become physically intelligible.

One other point of fundamental importance arises from the flux-cutting principle. The basic feature of wave propagation is that the displacing force due to acceleration balances the elastic controlling force. For a stretched cord transmitting a deformation of radius R, the displacing force is mV^2/R, which we can write down directly; but for electric waves we have to derive it by two stages $H' = j\varepsilon VE$ and $E' = -j\mu VH' = \varepsilon\mu V^2E$, that is, by reciprocal electric and magnetic induction. But Ampère's experiments on the forces on current-carrying conductors gave us $f = \mu \frac{ids\, i'ds'}{r^2} \sin\theta$ for the transverse force on either of two parallel current elements ids and $i'ds'$ separated by a distance r and making an angle θ with r. Hence if we have two charges e and e' moving with velocity V transverse to r, $f = \mu ee'V^2/r^2 = \varepsilon\mu V^2Ee'$, since $E = -e/\varepsilon r^2$, without any magnetic considerations. In conjunction with the above concept of a magnetic field as a translationally moving electric field, this suggests that 'magnetic force' should be regarded fundamentally

as simply a symbol for $4\pi[VD] = [VJ]$, that magnetism may with advantage be eliminated from all fundamental physical discussions, and that it may be possible to express the forces associated with protons and electrons at rest and in uniform and accelerated motion by a single comprehensive formula, thus eliminating both the curl- and flux-cutting equations. Such a change would be a great help towards clarifying fundamental problems, but it will take some time to formulate and assimilate, and in the meantime the flux-cutting equations and the simple physical concepts to which they lead should greatly facilitate the teaching and application of the Maxwellian theory.

The Athenæum, Pall Mall, S.W.1.
July 22.

C. V. DRYSDALE.

Radio Fadeouts, Auroras and Magnetic Storms

FROM observations made in the South Island of New Zealand we may add to the data already published in NATURE on the connexion between the radio fadeouts, auroras and magnetic storms of the two periods January 20–22 and January 24–26, 1937.

As reported from Canberra[1], the first of these periods of activity began with solar activity and poor reflection of wireless waves from the ionosphere. The wireless observations in New Zealand do not correspond exactly with those of Canberra. On beginning observations of the reflection of waves from the F_2 region at 2100 G.M.T. on January 20 no reflected wave could be observed and this fadeout lasted until 2305 hours, after which time weak echoes were obtained.

Magnetic conditions were moderately stormy during January 20 and 21 and an aurora was observed over New Zealand with its maximum phase at 0945 hours G.M.T., January 21. This faded out at 1100 hours. The magnetic storminess culminated in a major storm beginning at 0240 G.M.T., January 22 and during the entire night an intense auroral display occurred in the southern hemisphere with its maximum phase at 1045 G.M.T., January 22, when it was seen in Canberra.

The interval from 2100 hours January 20, when the radio fadeout was first observed, until 0240 hours January 22, when the magnetic storm began, is about 30 hours.

The intense aurora which accompanied the storm probably began during daylight, since complex echoes from the ionosphere which accompany such activity were observed.

On January 24 the Christchurch observations of the radio fadeout corresponded exactly to those made at Canberra. An interesting feature of the following period not already reported is that a good auroral display began in the southern hemisphere about the time of commencement of the magnetic storm at 1150 G.M.T., January 25. Through cloudiness it was not seen until 1315 G.M.T., but from the stage of development at that time it had probably started earlier.

This was in all probability the beginning of a period of world-wide auroral activity. The southern aurora mentioned above was followed by the intense aurora in the northern hemisphere[2] from 1800 G.M.T., January 25, until about 0230 G.M.T., January 26. This in turn was followed by another southern aurora observed in the evening from about 0900 h. G.M.T., January 26. It seems reasonable to assume that an intense daylight aurora may have been in progress in the southern hemisphere at the same time as that observed in the northern hemisphere, for during the whole period of ionospheric observations in Christchurch from 2100 hours, January 25, until 0530 hours, January 26, no echoes could be received from the ionosphere. The magnetic storm was in progress during most of this period.

The above auroral observations show that the estimated time interval of 39[1] hours from the solar eruption (at 0250 G.M.T., January 24) to the commencement of the aurora is too large, but that this interval should be about the same as that to the commencement of the magnetic storm, i.e., approximately 33 hours.

Ionospheric conditions in Christchurch appear to be similar to those observed at Tromsø by Appleton[3] during a magnetic storm and auroral display. It is found, for example, that 'no echo' periods often occur in the morning following a night of magnetic and auroral activity. The fadeout at 2100 G.M.T., January 20, may be of this type although no auroral or magnetic activity is known to have preceded it. Radio fadeouts coinciding in time with solar eruptions are observed as well as the periods of 'no echo' mentioned above. It would appear, therefore, that in high latitudes a radio fadeout may be due to ultra-violet radiation emitted during an eruption or may also be due to ionization by the particle radiation causing the auroras.

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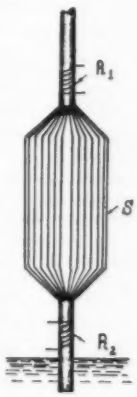
[1] NATURE, **141**, 746 (1938).
[2] NATURE, **141**, 232 (1938).
[3] *Phil. Trans. Roy. Soc.*, A, **236**, 191 (1937).

Further Experiments on Liquid Helium II

IN a previous note[1], we reported our investigation of the formation of a thin film of liquid helium II on the walls of a tube which is in contact with it. A very rough estimation of the thickness of the film was made from the amount of heat necessary for its destruction; it was found to be of the order 10^{-5} cm. The object of the further research was a direct determination of the thickness of the film.



The apparatus for the measurements is shown in the accompanying diagram. Here S is a cylinder of a great area, on the upper and lower part of which are soldered two tubes 4 mm. in diameter. A resistance thermometer R_1 of phosphor bronze wire 0·051 mm. thick is wound on the upper tube; a heating coil R_2 of constantan wire 0·1 mm. thick is wound on the lower tube. The lower part of the apparatus is immersed in liquid helium so that the heating coil is above the level of the liquid. In the presence of a

film of liquid helium II on the surface S, the thermometer R_1 indicates the temperature of the liquid helium II in the lower part of the apparatus. On switching on in the heating coil a current above the critical value[1], the film disrupts and the thermometer registers a rise of temperature in the upper part of the apparatus. This rise of temperature amounted to about 1°. No temperature rise occurred at currents below the critical value.

The procedure is as follows. The presence of the film is ascertained from the readings of the thermometer R_1. The current in the heating coil is then switched on, whereupon the film is disrupted. With current on, the dropping of the level of helium caused by evaporation is observed by means of a cathetometer. After a while, the current is switched off and, consequently, the film is allowed to form again.

The curve of the dropping of the level as a function of time is taken throughout the experiment. This curve exhibits a break and a jump at the moment the current is switched off. From the magnitude of this jump, the surface of helium in the Dewar vessel and the surface S, one easily finds the thickness of the film.

Three experiments were carried out with different areas of S, namely, 700 cm.², 2,800 cm.² and 10 cm.². In the first two cases, the jumps were $1{\cdot}5 \times 10^{-3}$, and $3{\cdot}5 \times 10^{-3}$ cm. respectively; as was expected, no jump occurred in the third case. Taking into account the quantity of helium evaporating during the cooling of the apparatus heated by 1° by the heating coil, we find from this data the thickness of the film to be 2 to 3×10^{-4} cm. It should be noted that the film is easily destroyed even by faint illumination. Therefore the experiments were carried out in a dark room and very faint light was used for observing the level.

Knowing the thickness of the film, it is possible to draw some conclusions on the thermal conductivity and the viscosity of liquid helium II (so far as thin films are concerned).

(1) Our experiments show that the transfer of heat even in a thin film is high. It is not likely to depend on convection, as the film is very thin. It may be, however, that the equalization of the temperature is merely due to the presence of the film and permanent evaporation of it.

(2) From the recent experiments of J. G. Daunt and K. Mendelssohn[2], who have determined the rate of transfer of liquid helium II on the surface of a solid in contact with it (an experiment analogous to that of these authors has been performed by us) one can, knowing the thickness of the film, estimate the viscosity of liquid helium therein. It proves to be much higher than the viscosity of liquid helium II, measured by P. Kapitza[3]. Of course our experiments refer to thin films only.

A detailed description of our experiments will be published in one of the Russian physical journals.

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June 20.

[1] Kikoin, A. K., and Lasarew, B. G., NATURE, **141**, 912 (1938).
[2] Daunt, J. G., and Mendelssohn, K., NATURE, **141**, 911 (1938).
[3] Kapitza, P., NATURE, **141**, 75 (1938).

Motion of a Spinning Top

IF a gyroscope is made with a heavy frame having a mass equal to or greater than the mass of the disk, then when the disk is set in rapid rotation about a vertical axis and the frame (provided with a supporting point) placed upon a smooth surface (Fig. 1*a*), the friction between the axle and the frame will soon set the frame in rapid rotation. In order to produce the proper amount of friction, the tightness of the axle in the frame is variable by means of an adjustable lock-nut. As the frame rotates about the vertical axis, it will take on a precessional rotation because of the pull of gravity. This precession gradually increases so that, at the right moment, the frame is rotating partially about an axis perpendicular to its plane. This angular velocity tends by centrifugal force to throw the frame into a position in which its plane is horizontal. This change takes place very suddenly, so that the top, flipping violently from one axis to another at right angles, continues to rotate about the second axis. The initial and final position are shown in the photograph.

(*a*) (*b*)

Fig. 1.

For best results the top should be rotated at high speed with an electric spinner. The friction between the axle and the frame must be exactly right. It is better to place the top upon a smooth metal plate, since then the frame can take up its rotation quickly without loss of energy to the supporting surface. The top should be designed to withstand high rotation speeds. It should not be touched after it is spinning on the plate since the tipping over is sudden and energetic.

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The Theory of Nuclear Forces

ACCORDING to the theory proposed by Yukawa[1] the neutron-proton interaction is due to the exchange of a particle having the elementary charge either positive or negative and a mass $m = \frac{\hbar \varkappa}{c}$, where $\hbar$ and c are Plancks constant and the velocity of light and $\frac{1}{\varkappa}$ is the range of nuclear forces. The proper description of these new particles, which have spin equal to one and obey Bose statistics, is obtained by quantization of the equations of Proca[2]. Introducing a *complex* four vector with components U^μ ($\mu = 1, 2, 3, 4$) and a *complex* antisymmetrical

world tensor with components $\chi^{\mu\nu}$ ($\mu, \nu = 1, 2, 3, 4$) these equations can be written

$$(1)\quad \begin{cases} \sum_{\nu=1}^{4} \dfrac{\partial \chi^{\mu\nu}}{\partial x^{\nu}} + \varkappa^2 U^{\mu} = 0 \quad (\mu = 1, 2, 3, 4) \\ \chi^{\mu\nu} = \dfrac{\partial U^{\nu}}{\partial x_{\mu}} - \dfrac{\partial U_{\mu}}{\partial x_{\nu}} \end{cases}$$

where $(x^{\mu}) = (x, y, z, ct)$ are the space-time co-ordinates and $\varkappa$ is the universal constant determining the range of the forces. Similar equations hold for the conjugate complex quantities $\widetilde{U}^{\mu}$ and $\widetilde{\chi}^{\mu\nu}$.

The charge and current densities connected with the new particles are given by the components of the four vector

$$(2)\quad S^{\mu} = e.i \sum_{\nu=1}^{4} (\widetilde{\chi}^{\mu\nu} U_{\nu} - \widetilde{U}_{\nu} \chi^{\mu\nu}) \quad (\mu = 1, 2, 3, 4),$$

which vanish only if the real and imaginary part of the field quantities have a constant ratio and in general represent particles of either positive or negative charge.

It has already been pointed out by several authors[3] that it might be necessary to introduce neutral particles also to account for the big forces between two neutrons and between two protons, and the question has been discussed what kind of field equations are suited for the representation of such particles. The only simple equations, however, which have the right spin properties and always give positive values for the energy are those of Proca, and it may therefore be of interest to remark that the solutions of (1) where the real and imaginary parts are not independent of each other and which accordingly give no contribution to the charge and current densities in (2) will just seem to be suited to represent such fields.

In that case it is, of course, only necessary to consider *real* field quantities U^{μ} and $\chi^{\mu\nu}$ and the representation of the nuclear fields shows, therefore, a striking resemblance to the ordinary electromagnetic theory from which the equations (1) only differ by the terms containing the universal constant $\varkappa$. Accordingly, the quantization of these equations can be performed exactly as in quantum electrodynamics, that is, the radiation field can be treated as an infinite number of harmonic oscillators or as an assembly of quanta. As regards energy and momentum these quanta will behave like material particles with rest-mass $m = \dfrac{\hbar\varkappa}{c}$, but, as in the case of photons, it is impossible to define a density in ordinary space of the heavy quanta, the particle properties of which result only from the quantization.

From this point of view the field theory based on the equations (1) offer possibilities of accounting for forces between like and unlike nuclear particles of a more general character than hitherto recognized. These consequences will be discussed in detail in collaboration with L. Rosenfeld in a forthcoming paper to be published in the *Proceedings of the Copenhagen Academy*.

Institute for Theoretical Physics, Copenhagen. July 9. C. MØLLER.

[1] Yukawa, *Proc. Phys. Math. Soc. Japan*, **17**, 48 (1935). Yukawa, Sakata, Taketani, *ibid.*, **20** (1938). Kemmer, NATURE, **141**, 116 (1938). Bhabha, *ibid.*, **141**, 117 (1938). Fröhlich, Heitler, Kemmer, *Proc. Roy. Soc.*, **166**, 154 (1938).

[2] Proca, *J. Phys.*, **7**, 532 (1936).

[3] Yukawa, *loc. cit.* Bhabha, *loc. cit.*

[4] Landau and Peierls, *Z. Phys.*, **62**, 188 (1930). Pauli, *ibid.*, **80**, 573 (1933).

Spectrum of Rubidium Hydride, RbH

A BAND spectrum of the many-line type has been obtained from a discharge through a mixture of rubidium vapour and hydrogen. The discharge tube with a constriction in the positive column which was originally designed for the production of the manganese hydride spectrum[1] was found to be an intense and economical source; the spectrum has been photographed on a 20-ft. concave grating spectrograph with exposures ranging from 10 to 40 minutes.

The spectrum, which extends from 4800 A. to 6500 A., is very similar to the already known spectra of the diatomic hydrides of the alkali metals, the bands being due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition and being strongly degraded to the red, so that the heads are poorly developed and have only been observed for some of the strongest bands. So far, nineteen bands have been classified, and a preliminary analysis leads to the following approximate values of the molecular constants:

ν_e	= 18912 cm.$^{-1}$	ν_0	= 18573 cm.$^{-1}$
ω_e'	= 248	ω_e''	= 934

The large difference between ω_e'' and ω_e' produces some uncertainty in the assignment of the values of v', and the values given below may have to be raised by one or possibly two units. The vibrational energy terms of the upper electronic state, like those for the hydrides of the other alkali metals, are anomalous in having a negative value of $\omega_e' x_e'$.

The following are the approximate positions of the heads of the strongest bands,

λ	v', v''	λ	v', v''
6277	0,3	5345	4,1
6178	1,3	5267	5,1
5871	1,2	5027	5,0
5782	2,2	4958	6,0
5694	3,2	4891	7,0
5422	3,1	4826	8,0

The investigations are being continued, and a rotational analysis is in progress.

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[1] Pearse, R. W. B., and Gaydon, A. G., *Proc. Phys. Soc.*, **50**, 201 (1938).

Surface Films of Gliadin

MITCHELL[1] has reported that under suitable conditions proteins can be spread from a solution to give films the force-area curves of which show a sharp transition point in the region of 1–2 dynes/cm., the extrapolated areas of the two distinct portions of the curve being approximately 0·3 and 0·7 $\times$ 10^{-7} gm./sq. cm. respectively. The requirements for such a curve seem to be (1) a dilute spreading solution, and (2) a time interval of 1–15 hours between spreading and measurement. Since this is the first case in which a definite transition point has been observed with proteins, we have repeated the measurements using, so far as could be ascertained, the same conditions as Mitchell. Dilute solutions of gliadin in 70 per cent aqueous alcohol were used for spreading on $N/100$ sulphuric acid or hydrochloric acid substrates, and the time interval ranged from 3 to 1,065 minutes.

There was no evidence at all of a transition point in any of the curves, and the time interval required for the film to reach equilibrium was only 5 minutes. If the interval was very large (greater than 1–2

hours) the curves indicated that the extrapolated area per molecule was becoming greater. Further investigation showed, however, that this effect was not real and that, in this series of experiments at least, the increase was due, not to a slow spreading of the protein, but to the inevitable accidental contamination of the surface with time. It is extremely doubtful whether a surface can be kept clean for as long a period as 15 hours without taking the most elaborate precautions[2].

The results obtained may be summarized as follows: column *A* gives the time interval between spreading and measurement, *B* the concentration of the spreading solution in grams of dried protein per 100 c.c. of solution and *C* the extrapolated density of the film in gm. $\times 10^{-7}$ per sq. cm.

Expt.	*A*	*B*	*C*
1	3	0·0048	1·33
2	5	,,	1·18
3	10	,,	1·18
4	10	,,	1·25
5	10	0·0094	1·25
6	10	,,	1·25
7	10	,,	1·20
8	10	0·0093	1·30
9	20	0·0048	1·18
10	20	0·0093	1·24
11*	70	0·0051	1·17
12	70	0·0048	1·23
13*	120	,,	1·03
14*	260	,,	1·08
15	375	,,	1·00
16*	410	,,	0·93
17	1065	,,	0·78

* *N*/100 HCl, remainder *N*/100 H_2SO_4.

For an interval of 5–70 minutes the extrapolated density of the film is fairly constant, the mean value (of experiments 2 to 12) being $1{\cdot}22 \times 10^{-7}$ gm./sq. cm. with an average deviation of $0{\cdot}03 \times 10^{-7}$. This figure (0·82 sq. metres per mgm.) compares favourably with the value of 0·9–1·0 sq. metres per mgm. obtained for various proteins on a substrate the *p*H of which is approximately 1·0 or is at the isoelectric point of the protein[3,4,5], but it is decidedly greater than Mitchell's value, $0{\cdot}57$–$0{\cdot}85 \times 10^{-7}$ gm. per sq. cm. After compression to 18 dynes/cm., the film could be expanded and recompressed to give a curve identical with the first compression. That the decrease in value of column *C* after 70 minutes is not due to a slow spreading was shown by correcting the curves for accidental contamination, obtained from a blank experiment over a similar period of time. Thus experiment 17 on correction gives an extrapolated density of $1{\cdot}25 \times 10^{-7}$. The correction applied must necessarily be approximate, and the agreement with the mean value of $1{\cdot}22 \times 10^{-7}$ is better than was expected; but there seems little doubt that the real cause is contamination and not a slow spreading phenomenon.

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July 12.

[1] *Trans. Far. Soc.*, **33**, 1129 (1927).
[2] Gorter and Philippi, *Proc. Acad. Sci. Amst.*, **37**, 788 (1934).
[3] Gorter and co-workers, *Proc. Acad. Sci. Amst.*, **29**, 371 (1925) *et seq.*
[4] Neurath, *J. Chem. Phys.*, **40**, 361 (1936).
[5] Fourt and Schmitt, *J. Phys. Chem.*, **40**, 989 (1936).

Duration of Action of Natural and Synthetic Œstrogens

In recent communications[1,2], details have been given of the œstrogenic activity of triphenyl ethylene in the mouse, the rabbit, the bitch and the monkey.

A number of derivatives of triphenyl ethylene have since been investigated for their œstrogenic effect and it has been found that triphenyl chlor-ethylene is considerably more potent.

Since a prolonged effect may be a desirable feature in the clinical use of œstrogens, experiments have been made to determine the duration of action of a number of natural and synthetic œstrogenic substances, namely, (1) œstradiol, œstradiol benzoate, œstradiol benzoate butyrate and œstradiol dipropionate; (2) triphenyl ethylene, triphenyl chlor-ethylene; (3) stilbœstrol.

The œstradiol benzoate butyrate and dipropionate were supplied by Dr. Miescher (of Ciba Ltd.) who recently described their prolonged effects in rats[3]. Stilbœstrol[4] was supplied by Dr. Carr, of B.D.H. Ltd.

The substances were tested in mice for their action on the vagina. The changes in the vaginal smear were determined in a quantitative manner by a method previously described[5]. The substances were given either (*a*) by subcutaneous injections in oil in four doses at 12 hourly intervals or (*b*) orally in a single dose in oil. The duration of the effects is shown in Tables 1 and 2.

TABLE 1. DURATION OF ACTION OF ŒSTROGENIC SUBSTANCES GIVEN BY SUBCUTANEOUS INJECTIONS.

Substance	Total dose (*μ* gm.)	Total duration of effect (approximate) in days	Duration until action halved (days)
Œstradiol benzoate	500	38	27
Œstradiol benzoate butyrate	50	> 120	95
Triphenyl ethylene	10,000	> 110	105
Triphenyl chlor-ethylene	500	> 130	123
Stilbœstrol	500	27	16

TABLE 2. DURATION OF ACTION OF ŒSTROGENIC SUBSTANCES GIVEN ORALLY.

Substance	Dose (*μ* gm.)	Total duration of effect (approximate) in days.	Duration until action halved (days)
Œstradiol	500	23	18
Œstradiol benzoate	500	20	15
Œstradiol di-propionate	500	18	13
Œstradiol benzoate butyrate	500	13	8
Triphenyl chlor-ethylene	500	17	14
Stilbœstrol	500	25	20

The results show that, when massive doses are compared, triphenyl chlor-ethylene given by subcutaneous injection (Table 1) has, weight for weight, a considerably more prolonged action than œstradiol benzoate, which is the œstrogen at present in common clinical use. Œstradiol benzoate butyrate has a more prolonged action than triphenyl chlor-ethylene. The duration of action of stilbœstrol is, in comparison, very short.

When given orally (Table 2), œstradiol has a more prolonged action than any of its compounds tested,

Œstradiol and stilbœstrol act for approximately the same time and their period of action is a little longer than that of triphenyl ethylene.

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Inhibiting Effect of Sodium Chloride on the Oxidation of Ascorbic Acid

IT was recently shown that sodium chloride (0·1 *M*) at *p*H 7·0 has an inhibiting effect on the oxidation of ascorbic acid[1,2]. Kellie and Zilva[2] showed in one experiment that sodium chloride (0·1 *M*) inhibited the catalytic power of copper at *p*H 7·0, but Barron *et al.*[3] did not succeed in demonstrating the same effect at *p*H 6·0. If it is true that sodium chloride has an inhibiting effect on the oxidation, it may be of the greatest domestic importance, for it has always been the practice of man to add salt (primitive people used sea water) to the water used for cooking meat and vegetables.

Experimental. Potatoes, cabbage and ox liver were cooked in glass-distilled water with and without addition of sodium chloride at a concentration of 1 per cent. Potatoes were cooked 45 minutes, cabbage and ox liver 20 minutes. The foodstuffs were added to the water after boiling had started. 10 gm. material was cooked with 200 ml. water. The foodstuffs were ground up with quartz and in 10 per cent trichloracetic acid and analysed by the method of Emmerie and van Eekelen[4,5]. In the table the numbers are the results of double analyses made on different materials. They are given as percentages of the original content of ascorbic acid in the raw substance.

	Cooked in distilled water			Cooked in distilled water with 1 per cent sodium chloride		
	In substance %	In water %	Total %	In substance %	In water %	Total %
Peeled potatoes	93	13·5	106·5	107	17	124
Cabbage	54	20·5	74·5	32·5	56	88·5
Ox liver	46	44	90	38	52	91

Thus we find 16–19 per cent more ascorbic acid left when vegetables are cooked in salt solution than in vegetables cooked in distilled water. In agreement with McHenry and Graham[6], we found considerably more ascorbic acid in cooked than in raw potatoes. These authors claimed that ascorbic acid in raw vegetables were partially fixed as esters which are hydrolysed by cooking. Van Eekelen[7] repeated their experiments with another technique using 3 per cent trichloracetic acid for the grinding medium, and found that potatoes, in fact, lost ascorbic acid by cooking; he explained the remarkable results of McHenry and Graham as being due to action of enzymes during the grinding process. In our experiments such an action of enzymes is excluded, since we used strong trichloracetic acid as grinding medium. We know of no other observations suggesting that ascorbic acid in vegetables is fixed in the form of esters. In our opinion, the phenomenon is easily explained by the fact that it is very difficult to extract ascorbic acid quantitatively from raw vegetables, especially when strong trichloracetic acid is used, and the extraction has to be done quickly in order to avoid destruction of the ascorbic acid.

The main purpose with this communication, however, is to point out that vegetables cooked in water containing sodium chloride appear to keep their ascorbic acid better than vegetables cooked in distilled water.

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Regeneration of Root Cuttings as Influenced by Plant Hormones

ROOT cuttings (thongs) of sea-kale (*Crambe maritima*) under suitable conditions produce, whichever way up they are inserted in the rooting medium, buds and roots at the morphological apex (proximal end) and base (distal end) respectively (Fig. *C*). This phenomenon of polarity has been explained by Went and Thimann in terms of the polar transport of auxin—"polarity can now be expressed quantitatively as a function of the transport of a known substance in the tissues"[1].

Experiments here tended to suggest that the production of buds and roots is possibly dependent on the local concentration of growth substances within the tissues. Thongs 7 cm. in length were used. The morphological apices were treated for 20 hours with a solution of α-naphthalene-acetic acid (0·02 per cent). After 14 days, roots had been produced both apically and basally (Fig. *A*). The length of the roots varied from 1 cm. to 5 cm. No buds were produced at the apex. These observations implied that under normal conditions the presence of a relatively high but quantitative amount of growth substance determines the production of roots. Bud production, on the other hand, may be associated with a relatively low concentration of growth substance. Proof of this would lie in the production of buds basally as well as apically. Thus, assuming the polar transport of auxin from all regions to the base, it would be necessary to remove this accumulating auxin and therefore lower the concentration at the base. A possible method of achieving this lay in washing the thongs in running water for 48 hours, but this produced no effect upon the subsequent behaviour of the cuttings. A second method which eventually proved successful was to remove approximately a millimetre of tissue from the base and apex of the thongs every five

days for a period of eight weeks. At the end of this time about 25 per cent of the thongs had produced buds at both ends (Fig. *B*). Thongs which failed to produce buds basally were either still producing roots in this region or were merely callused. The decapitation treatment was continued on the latter material, and after another four weeks most of the thongs had produced buds at the base with no activity at the apex.

The quiescence of the apex may possibly be attributed to auxin depletion coupled with carbohydrate exhaustion. Removal of buds from the thongs bearing buds at both ends followed by total immersion of the thongs in a 0·02 per cent solution of α-naphthalene-acetic acid resulted in the production of roots over the whole length. Roots and buds formed in anomalous positions showed normal subsequent growth.

A. Roots at both ends | *B*. Buds at both ends | *C*. Normal thong

From these experiments, it is suggested that whatever other substances may be concerned in bud and root production as proposed by Went[2], not only the subsequent growth but also the initial differentiation of meristematic tissue is determined, at least in part, by the local concentration of growth substance.

Further experiments will be directed to the possible production of buds by the application of growth substances to tissue whose supply of auxin has been artificially depleted and to the estimation of auxin concentrations, if any, in the different parts of the thong.

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Nucleic Acid Metabolism of the Chromosomes in Relation to Gene Reproduction

A RELATION between the nucleic acid metabolism of the chromosomes and their reproduction is suggested by the localized appearance of thymonucleic acid in the chromosomes preparatory to their division[1]. The study of the nucleic acid metabolism of the salivary chromosomes and of the egg cytoplasm in certain variegated races of *Drosophila melanogaster* has now given evidence of a relation between nucleic acid metabolism and gene reproduction. The variegation in these races is due to an abnormality of gene reproduction, consequent upon chromosome rearrangements[2] involving the 'heterochromatic' regions[3]. Cytologically, the variegation is correlated

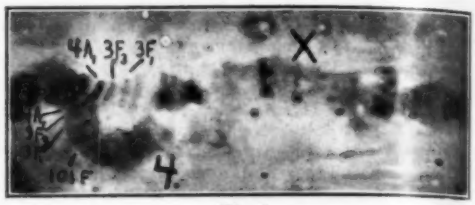

Fig. 1.

A PHOTOGRAPH, TAKEN AT 275 Mμ SHOWING A NORMAL *X*-CHROMOSOME SYNAPSED WITH ONE OF THE CHROMOSOMES RESULTING FROM A RECIPROCAL TRANSLOCATION BETWEEN THE *X*- AND THE FOURTH CHROMOSOMES. THE LABELS ON THE BANDS ARE THOSE OF BRIDGES' REFERENCE SYSTEM FOR THE SALIVARY GLAND CHROMOSOMES (*J. Hered.*, 1938).
Nucleic acid contents of the labelled bands in 10^{-11} mg.: $3F_1$: normal 8, translocation 33; $3F_3$: normal 14, translocation 50; $4A_1$: normal 95, translocation 94.

with deficiencies in the salivary gland chromosomes for the bands closest to the point of rearrangement, and with a darkening of the immediately adjacent remaining bands which suggests a change in their nucleic acid balance[3].

Fig. 2.

ABSORPTION SPECTRUM OF THE CYTOPLASM OF THE *Drosophila* EGG.

The nucleic acid content of the bands placed close to the heterochromatic regions in such rearrangements and of their normal homologues has been measured by a photographic method[1]. An increase occurs, which is greatest close to the heterochromatic regions, and less farther away (Fig. 1). Due to the occurrence

of deficiencies of various sizes (short ones prevailing in the presence of an extra *Y*-chromosome[4,5,2], longer ones without a *Y*) it has been possible to show that the closer a given band is to the heterochromatic region, the greater the augmentation of its nucleic acid content. It seems not unlikely that the increase in nucleic acid is an intermediate stage between the normal condition and the loss of a band.

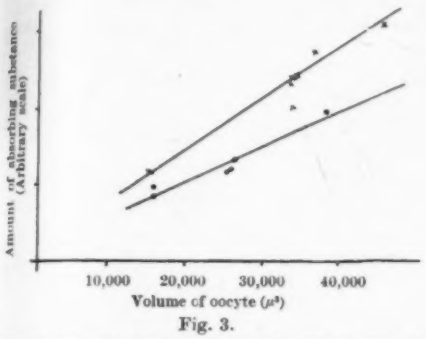

Fig. 3.

COMPARISON OF THE AMOUNT OF SUBSTANCES ABSORBING ULTRA-VIOLET LIGHT AT 257mμ IN THE OOCYTES OF AN *XX*- AND AN *XXY*-FEMALE. Crosses represent the values from *XXY*, points those from *XX* ovaries. The *XXY* values are consistently higher.

The cytoplasm of the egg gives further evidence of a correlation between nucleic acid metabolism and variegation. Its absorption spectrum in the ultra-violet (Fig. 2) measured by a photo-electric method[1] shows the presence of a high concentration of substances containing the pyrimidine ring (hence related to nucleic acid)—a situation similar to the high concentration of nucleotides reported in marine eggs[6]. A comparison of the amounts of such substances in the oocytes of *XX*-females and of *XXY*-females (Fig. 3) shows an increase due to the presence of the extra *Y*-chromosome. It is known that the presence of an extra *Y*-chromosome in the mother results in the appearance of less variegation in her progeny[7].

These results show effects of the heterochromatic chromosome regions on the nucleic acid content of bands in the same chromosome (in genetical terms, a position effect); on the nucleic acid content of bands in other chromosomes; and on the amount of substances related to nucleic acid in the egg cytoplasm. They suggest that the apparent genetically inert character of these regions is merely the consequence of their specialization in performing a function also performed by all other genes—namely, the synthesis of nucleic acid. The relation of these regions to the variegation, taken together with the local appearance of nucleic acid in the chromosomes, suggests that the synthesis of nucleic acid is closely connected with gene reproduction. The structure-forming properties of thymonucleic acid[8], and its ability to form high-molecular weight polymers[9], as well as the correspondence of its X-ray diffraction pattern with that of the proteins[12], suggest a basis for this function.

These considerations have an especial interest in the case of the other self-reproducing molecules—the viruses and the bacteriophage—all of which have been shown to contain nucleic acid[10,11]. Moreover, in the inactivation of the bacteriophage by ultra-violet light, the curve for the efficiencies of the different wave-lengths does not agree completely with that of the bacteriophage, but does with the nucleic acid absorption spectrum. It seems hence that the unique structure conditioning activity and self-reproduction, possibly by successive polymerization and depolymerization, may depend on the nucleic acid portion of the molecule. It may be that the property of a protein which allows it to reproduce itself is its ability to synthesize nucleic acid.

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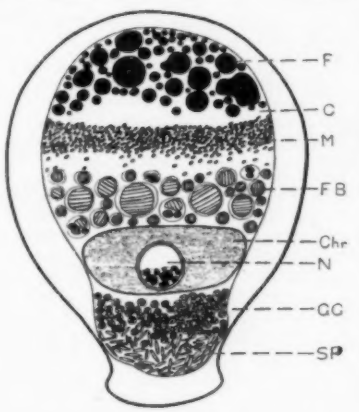
Effect of Ultracentrifuging on *Nebela collaris* Leidy (pro parte)

IN *Nebela collaris*, the cytoplasmic bodies are the glycogen granules, chromidium, mitochondria, one to two contractile vacuoles and sudanophil fat.



The accompanying illustration shows the stratification of the various cytoplasmic components according to their specific gravity after ultracentrifuging. Fat (*F*) and the contractile vacuoles (when present) being lightest, occupy the centripetal position. There follow in turn a clear cytoplasmic area (*C*), the mitochondria (*M*), numerous food-bodies (*FB*) and the chromidial substance (*Chr.*) which contains the nucleus (*N*) near its lower limit. The nuclear contents have collected towards the heavy side of the

cell. The glycogen granules (*GG*), which have been displaced from the chromidium, lie above the shell plates[1] (*SP*), which, as the heaviest component of the cell, occupy the extreme centrifugal position.

It is interesting to note (particularly in this case where a chromidium is present) that no homologue of the Golgi apparatus appears to exist in *N. collaris* and that the contractile vacuoles do not blacken with osmic acid even after prolonged periods.

Singh[2], working on *Amœba proteus* Y, found no homologue of the Golgi apparatus and also that the contractile vacuole did not blacken even after prolonged treatment with osmic acid.

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Eocene Beds in Waziristan

I SEE that Dr. Heron[1] now accepts the fact that Ranikot beds exist in Waziristan. The evidence for this is, indeed, overwhelming, as I have pointed out elsewhere[2]. He says, however, that Dr. Coulson could not state whether the Khirthar overlaps on the Ranikot to the north of Kotkai, so perhaps I may be allowed to quote my own observations.

Middle Khirthar (Lutetian) beds to the north, in Waziristan, unquestionably overlap on the Ranikot (Paleocene); all intermediate elements, including the Lower Khirthar, being locally absent.

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[1] *Records Geol. Surv. Ind.*, **73**, 83 (March 1938).
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Points from Foregoing Letters

DR. C. V. DRYSDALE outlines some novel views on the nature of electrical fields of force in connexion with the flux-cutting equations, which he advocates in order to facilitate the teaching of Maxwellian theory. He considers that an uncharged body is surrounded by two equal and opposite electric fields, and that a linear current must be surrounded by two opposed electric fields moving translationally past each other, and being thus equivalent to a magnetic field. This picture is further elaborated to account for Drude's dispersion theory, Fresnel's drag coefficient and the electromagnetic wave propagation.

From observations made in the South Island of New Zealand on radio fadeouts, auroras and magnetic storms which occurred on January 20–22 and 24–26, Prof. F. W. G. White, H. F. Skey and M. Geddes conclude that in higher latitudes a radio fadeout may be due to ultra-violet radiation emitted during an eruption, or may be due to ionization by the particle radiation causing the auroras. They estimate the time interval from the solar eruption to the commencement of the aurora to be about 33 hours.

By means of an arrangement which allows the formation and the destruction of a thin liquid film of helium II upon a surface of known area, and allows the measurement of the amount of helium taking place in this process, A. K. Kikoin and B. G. Lasarew find the density of the helium film to be 2 to 3 $\times$ 10^{-4} cm. The viscosity of the film is much higher than that determined by Kapitza for liquid helium II in bulk. The heat transfer in the film is high, but may depend upon surface evaporation.

Dr. C. Møller suggests that the part of the nuclear forces which cannot be accounted for by the idea of the heavy electron can be derived from the supplementary assumption of a heavy neutral particle with properties very similar to those of the photon.

A. G. Gaydon and Dr. R. W. B. Pearse give the approximate positions of the heads of the strongest bands in the spectrum of RbH, obtained by means of an electric discharge through a mixture of rubidium vapour and hydrogen, and they calculate the approximate values of its molecular constants.

A table showing the change with time in the extent of surface films of the protein gliadin is given by G. I. Jenkins and T. W. J. Taylor. The authors calculate the average density during the first 70 minutes to be $1{\cdot}22 \times 10^{-7}$ per gm./sq.cm. This value decreases with time owing to contamination of the film with surface-active impurities. The experiments do not confirm Mitchell's sharp transition point in the region of 1 to 2 dynes/cm. per cm.

Tables giving the duration of the œstrogenic effects of several œstradiol and triphenyl ethylene compounds, administered orally or by subcutaneous injections, are submitted by Dr. J. M. Robson, A. Schönberg and H. Ahmad Fahim. Triphenyl chlorethylene given subcutaneously has a more prolonged action than œstradiol benzoate.

Peeled potatoes and cabbages cooked in water containing 1 per cent of common salt appear to retain their ascorbic acid (vitamin C) better than vegetables cooked without salt, according to experiments by A. Høygaard and H. Waage Rasmussen. Sodium chloride is known to inhibit the oxidation of ascorbic acid.

Treatment of root cuttings of sea-kale for twenty hours with a solution of α-naphthalene-acetic acid leads to the formation of roots both apically and basally, while the removal of about 1 mm. of tissue from base and apex every five days for eight weeks produces buds at both ends. This, Prof. R. H. Stoughton and W. Plant point out, indicates that the initial differentiation of meristematic tissue is determined at least in part by the local concentration of growth substances.

Differences from the normal values in the nucleic acid content of the salivary gland chromosomes in races of *Drosophila melanogaster* exhibiting variegation have been demonstrated by Prof. T. Caspersson and Dr. J. Schultz by optical methods. Taken together with other data on viruses and chromosomes, the present results suggest the possibility that nucleic acid synthesis is characteristic of self-reproducing molecules.

Lieut.-Colonel L. M. Davies states that Middle Khirthar (Lutetian) beds unconformably succeed Ranikot (Paleocene) ones in northern Waziristan.

Research Items

Physical Fitness

In a paper contributed to the recent British Medical Association meeting, Prof. E. P. Cathcart of Glasgow discussed the various factors that go to form the basis of physical fitness (*Brit. Med. J.*, August 6, p. 273). We require to keep a broad and open mind on the problem of how best to achieve fitness—just as there is no one cause of unfitness, so there is no one solution. It will not be achieved merely by satisfaction of the needs of the body, for malnutrition of the spirit is quite as common as malnutrition of the body, and the one reacts upon the other. Discipline is essential for right living, and right living means health. As regards actual factors, muscular activity in the form of physical training is necessary, but must be of the right kind, and posture and carriage are important; but these vary to some extent for the two sexes and for different individuals. The dietary aspect was briefly considered. There is evidence that meat is not essential, and perfect fitness may be acquired on a diet of brown bread, milk, butter, cheese, fresh fruit and salad, provided it is adequate. For heavy work, fat appears to be an important source of energy. Sugar and carbohydrates are known to be important sources of energy; but apparently are not immediately available, but have first to be converted into glycogen, so that Krogh *et al.* suggest that in sporting events the athlete should have two days' rest before the contest to secure a complete filling up of the glycogen stores of the body.

South American Head Hunters

The Jivaro Indians of eastern Ecuador have long been notorious for their custom of preparing shrunken heads as trophies of their enemies killed in battle. Much inaccurate information has been recorded concerning them, and their method of preparing the shrunken heads has been shrouded in much unnecessary mystery. The literature relating to their culture, including early Spanish records hitherto somewhat neglected, has been analysed and sifted by Dr. W. M. Stirling, and supplemented by ethnographical material obtained in the field in 1930–31 (*Smithsonian Institution Bull.*, 117; 1938). The Jivaro, who live scattered over an area of approximately 25,000 sq. miles, are everywhere of similar appearance physically, speak a single language, and their customs, beliefs, and material culture are closely interrelated. They live in small independent groups, for the most part on the head waters of tributary streams of the rivers running through their territory. The groups are constantly at war with one another. Their intelligence, fine physique and independent air creates a favourable impression on the visitor. In the study of supernatural beliefs, war customs, and head-hunting, it is demonstrable that their practice, in common with other cultural traits, is not peculiar to them, but was formerly typical over a wide area in the northern Andes. Apparently the blow-gun is a post-Columbian introduction. The high civilization of the Andes at the beginning of the sixteenth century differed from the rather primitive culture of the Jivaros mainly in superficial aspects. A study of the Jivaros to-day and of the ancient tribes of the western Andes, as viewed in historical perspective, seems to indicate that they merely represent different degrees of development from a common cultural background. As regards head trophies, a number of actual examples have been recovered from graves of the ancient culture in the Nasca region. These were not shrunken, though there is evidence that the people preparing them had either made shrunken heads themselves or had been in contact with a people who followed that practice. They still skewered or sewed the lips, though this process was not necessary in mummification.

Chinook Culture

The Lower Chinook have been assumed since the last decade of the nineteenth century to be extinct. One member of this people furnished Dr. Boas with information in 1890–91. In 1930 Mr. Verne F. Ray was informed of the survival of two other members, both women of considerable age. The material obtained from them by Mr. Ray in two expeditions to the Willapa Bay region and the lower Columbia River have been embodied in a series of ethnographic notes (*Univ. Washington Pub. in Anthrop.*, **2**, 2; 1938). The name Chinook is derived from a Salishan term of the Chehalis dialect, and although the Chinook themselves have no designation for a larger political unit than a village, there is reason to believe that the people of the villages north of the Columbia River did use the term in self-reference, even before the appearance of the whites. The Chinook in the early nineteenth century occupied both sides of the river for a distance of fifty miles from the mouth. The term Lower Chinook is here used to designate the people of Willapa Bay and the lower river. The population in 1806 was estimated at 1,100. After the smallpox epidemic of 1853 it numbered one hundred. The Chinook lived in villages, each of which was autonomous under a chief. The people were divided into upper class and lower class, with a class of intermediates, composed of wealthier members originating from the lower class, and the less energetic and unambitious, or remoter relatives, of the upper class. Class feeling was strong. There was a slave population, which relieved the housewife from the more onerous duties of domestic life. Most of the slaves were obtained by purchase from surrounding peoples. The habitat was dominated by the two great connecting bodies of water, Willapa Bay and the Columbia River. On these most villages were situated and most travelling was done. The region belongs to the Humid Transition plant life area, and was well supplied with trees, vegetation and animal life. It is probable that few areas of the world could have provided a more desirable habitat than that occupied by the Chinook.

Hydrodictyon in South Africa

Algologists will be glad that Miss Pocock is following her treatise on *Volvox* by studies of other algæ of the South African vleis. She has now given a description of first-hand observations of two species of *Hydrodictyon* (*Trans. Roy. Soc. South Africa*, **24**, Part 3; 1937). Most of the paper is concerned with *H. patenaeforme*, sp. nov., a species formerly referred

to *H. reticulatum* or *H. indicum*, but now separated on account of the saucer shape of the nets and the smaller number of component coenocytes; in this connexion, Miss Pocock points out that these might be features of a permanent youth form of *H. reticulatum*, and in this case the South African plant may be only a form of the latter species associated with the absence of asexual reproduction under the local conditions. The photographs and description of the germinating polyhedra are very clear, and it is of interest that the angular thickenings of the wall are absorbed into the membrane during expansion. The whole process of zoospore and net formation was observed to take place rapidly during the first five hours following midnight. The processes of gamete formation and copulation were observed and the author emphasizes the enormous number of gametes produced. The gametes come into contact laterally and fuse whilst still actively motile, forming bi-ciliate zygospores, which also remain active for some time. In *H. africanum* asexual reproduction has not been seen, but reproduction by gametes is similar to that described for *H. patenaeforme*. The separated coenocytes, commonly occurring in the later stages of the alga, appear to have no reproductive function.

Poultry and Poultry Manure

THE maintenance of grassland for poultry and the value, storage and utilization of poultry manure is the subject of an interesting bulletin by A. W. Ling and W. R. Muir (Bull. 20, Dept. of Agric. and Hort., Univ. of Bristol). Although it is only within recent years that attention has been paid in Great Britain to grassland in relation to poultry, the improvement that can be brought about on poor pasture by a folding system is now well known, it being possible to convert old down-land into a second-grade cow pasture in twelve months. The method as practised on the drier calcareous soils of the West Country consists of a number of fold units, each containing twenty-five adult birds, the folds being moved daily so that a single unit covers one acre each year. By this system the land is not fouled, the droppings are deposited evenly without loss of soluble constituents and the land is subjected to intense mechanical treatment. As regards the effect of the grass on the poultry, the birds are kept clean and provided with green vegetable matter and protein, but it is essential that the herbage be kept short, by other stock or the mower if necessary, for tufted, rank grass has but little feeding value and is refused by the birds. Frequent liming of land folded to poultry is essential, both to correct soil acidity and to counteract the excessive nitrogenous deposits, ground burnt lime at the rate of 1–2 tons per acre per annum being an average dressing. Moreover, lime in this form will act as a useful disinfectant. Potash as kainit (3 cwt. per acre every fourth year) is also recommended, as intensive poultry penning upsets the balance between phosphate and potash in the soil. The bulletin concludes with practical advice, derived from carefully conducted experiments as to the best utilization of poultry manure.

Pulp Materials

A REVIEW of the pulp and paper resources of the Empire (*Bull. Imp. Inst.*, **36**, No. 2) directs attention to the general question of raw materials for the paper and allied industries that depend on timber. The outlook stresses the importance of research on new materials. The world consumption of pulp is rapidly growing. It is required not only for paper and various kinds of boards but also for rayon, 'Cellophane', plastics and lacquers. There are, however, indications that the demand for lumber as apart from pulp is slightly diminishing and so affording some relief on forest resources. In Europe, the Scandinavian countries can hold their own by wise afforestation, but cannot materially increase their output of pulp. The U.S.S.R. has vast untapped forests, but her own demands grow as transport improves and Russia is not likely to expand greatly her export. The Canadian forests will be fully taxed to meet the growing requirements of American newsprint. Newfoundland is increasing her export, but on the whole it is clear that the Empire in particular and the world in general urgently requires new pulp resources. Attention is directed to the possibilities: bamboos and other grasses, waste materials such as sisal waste, cotton stalks, rice straw, etc., and various tropical timbers. Any potential material must be available in large quantities, at low cost in a reasonably accessible area.

Advance and Retreat of Glaciers

THE complicated relations between climate and the advance and recession of glaciers have recently been discussed by Prof. H. W. Ahlmann and Mr. S. Thorarinsson in an article on the Vatnajökull Glacier (*Geog. Rev.*, July). It is generally accepted that a maritime, in contrast to a continental, climate is favourable to glaciation but, the writers point out, there is a limit to the extent that maritime conditions favour glaciation. That limit is reached when the influx of humid and mild air compensates increasing accumulation by extending the ablation period. Unless a temperature reduction ensues, the glaciers will begin to waste. It is thus obvious that in differing altitudes of mountain regions various glaciers react differently to minor climatological changes: some recede while others advance. In regions with a continental climate a reduction of temperature is probably accompanied by a diminution of precipitation and so by a recession of glaciers, which, however, may leave room for the invasion of glaciers from adjacent regions where precipitation is more active and where the reduction of temperature, by checking ablation, has allowed the glaciers to grow. Another factor of importance is the thickness of the glacier. Deglaciation decreases thickness and, in time, causes rapid marginal recession. The land thus laid bare of ice reacts on the local climate and a change ensues apart from any general climatic change. Conversely the spread of glaciation may in time check the advance of humid winds and so put a stop to the advance and even promote the recession of the ice.

Soil Erosion in East Africa and Australia

THE problems of soil erosion in Tanganyika have recently been discussed at length by the director of agriculture (Tanganyika Territory, 1937: Report by H.M. Government to the Council of the League of Nations. H.M. Stationery Office. 4*s*.). While not denying that soil erosion in certain areas is a serious menace, the director points out that the greater part of the territory is not seriously menaced by this threat, since the cultivated soil area is only about one thirtieth of the whole, and he calculates that, taking all causes into account, not more than one tenth is really in danger. Overstocking of grazing land is

one source of this danger, but from the native point of view is frequently a necessary evil. Land with persistent vegetation favours ticks, flies and worms which harm livestock. Overstocking promotes aridity which reduces the incidence of parasitic disease, and thus is favoured by native stockowners even at the risk of occasional losses from starvation. It is admitted, however, that something might and ought to be done to prevent or at least discourage overstocking. It is noted also that the tsetse-fly, by infesting grazing lands, may cause overstocking of other lands, while in some cases it decreases stock to the extent of promoting the spread of vegetation and so checks soil erosion. While various methods of fighting soil erosion are advocated, most stress is laid on educative and legislative measures to govern all cultivation. The subject of soil erosion in general and its cure is also discussed at length, especially in reference to Australia, by Prof. Macdonald Holmes in "The Meaning of Soil Erosion" (University of Sydney Publications in Geography No. 1. Price 2*s*. 6*d*.).

Earthquakes and the Surface Structure of the Earth

KATSUTADA SEZAWA has recently published a paper on the amplitudes of Rayleigh waves with discontinuities in their dispersion curves (*Bull.* Earthquake Res. Inst., Tokyo Imperial University, **16**, Pt. 1; March 1938). In this, he follows up an earlier investigation by himself and Kiyoshi Kanai in which they obtain formulæ exhibiting the relation between the thickness of a surface layer and the amplitudes of dispersive Rayleigh waves, by calculating tables to show that the discontinuity in these dispersion curves does probably exist. The particular case considered is one in which a stratum has beneath it material which is considerably stiffer, and the results therefore apply to waves transmitted along a surface stratum up to a few hundred metres thick. In such a case the ratio of wave-length to thickness of the layer is large, and the surface displacement is mainly horizontal when the usual Rayleigh waves are considered. If, however, an earlier phase of the waves the equation of which is obtained by the authors is considered, then a transmission of bodily waves of large vertical displacement should be expected. A similar, though probably more general investigation has been carried out by Stoneley-Rayleigh waves in a heterogeneous medium (*Mon. Not. Roy. Astro. Soc.*, Geophys. Supp., **3**, No. 6; May 1934). This work is more general in its applicability to the actual conditions existing on the earth. It can be applied to a heterogeneous layer resting on a homogeneous substratum, or to conditions in which the rigidity of the strata vary linearly with distance from the plane of junction.

Petroleum Fuels in Canada

A FURTHER bulletin (No. 789) has now been issued by the Canadian Department of Mines giving statistics of petroleum fuels delivered for consumption in Canada during the year 1936. These statistics are directly comparable with those issued by the same Department for the years 1933, 1934 and 1935 (Nos. 772 and 780). In 1936, 1,213 million Imperial gallons of petroleum products were delivered in Canada for fuel, the total being made up of 555 million gallons of fuel oil, 34 million gallons of kerosene and 624 million gallons of gasolene. In addition, more than 45 thousand short tons of petroleum coke were delivered for the same purpose. More than 89 per cent of fuel oil (as compared with 85 per cent in 1935) was processed in Canadian refineries, the remainder consisting of imported fuel oil. Of this, more than 22 per cent was used for domestic heating, 28 per cent for industrial heating and power, 6 per cent for tractor fuel and 44 per cent for rail and water transportations. Kerosene deliveries in 1936 again represented only one thirty-third of the aggregate of all petroleum fuels. In fact, more than 1½ million gallons less kerosene were delivered than in 1935. 67 per cent of the total was used for domestic heating, cooking and lighting, 30 per cent for tractor fuel and 3 per cent for miscellaneous uses. The sales of gasolene in 1936 showed an increase of nearly 50½ million Imperial gallons as compared with 1935.

Detection of Hydrogen Cyanide

LEAFLET NO. 2 of "Methods for the Detection of Toxic Gases in Industry" (Department of Scientific and Industrial Research, price 5*s*. 6*d*. net) deals with hydrogen cyanide. Leaflet No. 1 (price 3*s*. 6*d*.) dealt with hydrogen sulphide. The leaflet No. 2 describes a method of detection of hydrogen cyanide which consists in drawing air by means of a hand-pump through a test-paper impregnated with Congo red-silver nitrate or benzidine-copper-acetate, which are capable of detecting concentrations down to 1 part in 100,000 by the production of characteristic stains, specimens of which are included on a card with the leaflet.

Thermal and Photochemical Decomposition of Mercury Dimethyl

RECENT papers from Prof. H. S. Taylor's laboratory at Princeton on exchange reactions involving the simpler saturated hydrocarbons have indicated the importance of the reaction $CH_3 + H_2 \rightarrow CH_4 + H$ as an intermediate process. In order to obtain information regarding the energetics of this reaction the thermal and photochemical decompositions of mercury dimethyl [$Hg(CH_3)_2$] have been studied by J. P. Cunningham and Prof. H. S. Taylor (*J. Chem. Phys.* **6**, 359; 1938). The thermal decomposition does not proceed at measurable speed below 290°. Above this temperature $Hg(CH_3)_2$ alone yields a complex mixture of methane, ethane and a carbonaceous deposit, most probably a polymer of CH_2. Addition of hydrogen accelerates the decomposition but now the products consist almost solely of methane and there is no carbonaceous deposit. Photochemical decomposition, from 50° to 300°, in the absence of hydrogen, gives practically nothing but ethane below 200° but, in the presence of hydrogen, methane is formed at all temperatures and the higher the temperature the greater the amount of methane formed. The processes involved are the photo-decomposition of the dimethyl to give free methyl radicals [$Hg(CH_3)_2 \rightarrow 2CH_3 + Hg$] which combine to give ethane [$2CH_3 \rightarrow C_2H_6$]. The methane formed is accounted for, in the presence of hydrogen, by the reactions $CH_3 + H_2 \rightarrow CH_4 + H$; and $H + Hg(CH_3)_2 \rightarrow Hg + CH_4 + CH_2$ and, in the absence of hydrogen, by

$$CH_3 + Hg(CH_3)_2 \rightarrow CH_4 + CH_2HgCH_3$$

$$CH_2HgCH_3 \nearrow CH_3 + HgCH_3$$

$$\searrow CH_3 + Hg + CH_3$$

$$CH_3 + CH_3 \rightarrow CH_4 + CH_2.$$

The influences of temperature, pressure, and surface on the nature and amounts of products have been noted. The activation energy of the reaction $CH_3 + H_2 \rightarrow CH_4 + H$ is 9 ± 2 kgm.-cal.

Royal Society of Canada

Ottawa Meeting

THE annual meeting of the Royal Society of Canada was held in Ottawa on May 24–27, under the presidency of Prof. A. G. Huntsman of the University of Toronto. Twelve new fellows were elected in the scientific sections, and Dr. Victor Morin of Montreal was elected president for 1938–39.

Dr. Huntsman's presidential address, "The Problem of Life", considered the life-history of the salmon, following which it discussed philosophically the relation between the physical universe and mental processes.

Mathematics, Chemistry and Physics

The meetings of Section III (Mathematical, Chemical and Physical Sciences) were held under the presidency of Prof. R. H. Clark, who gave the presidential address to the Section on enzyme activators, in which he pointed out evidence suggesting that the action of such chemical materials as hormones, vitamins and bios manifests itself through the activation of some enzyme or bacteria. In all, ninety-nine papers were presented of which about half were given by title only. Among the papers read by the fellows, mention may be made of that by Prof. S. Beatty "On the Cycles of an Algebraic Equation $f(x) = 0$ Relative to Infinity" and "The Stability of Plane Poiseuille Motion" by Prof. J. L. Synge. Prof. R. L. Jeffrey indicated in a paper on "Integration in Abstract Space" the essential difference between the theories of Bochner and Birkoff. A paper of some practical importance in determining the lateral support of towers supported by guy wires was read by Prof. I. W. Campbell. Mr. R. Meldrum Stewart gave an interesting account of the new time signal clock which has been installed at the Dominion Observatory which embodies the two special features of possessing robust electrical contacts and an arrangement for synchronization directly from a precision sidereal clock. A discussion of the results of observations made at Ottawa on the redward shift of spectral lines near the solar limit was presented by Dr. R. E. DeLury.

Among the papers read in the chemical section by Dr. E. W. R. Steacie, mention may be made of one "On the Mercury Photosensitized Decomposition of Ethane" in collaboration with N. W. F. Phillips in which the reaction was traced by separate steps from C_2H_6 to C_2H_2. A series of nine papers were presented by Prof. O. Maass and his associates dealing with viscosity measurements, rates of reaction, specific heat and density measurements of various gases and liquids in the critical temperature and critical pressure region. Prof. W. Lash Miller gave further results of experiments on Wilders' bios. Dr. W. H. Barnes in collaboration with H. B. Yuen presented a translation of an interesting Chinese paper on the Chinese alchemist T'ao, the recluse.

Among the papers dealing with physical topics, Prof. J. S. Foster and Dr. A. Vibert Douglas presented the results of an investigation on the analysis of the Stark effect in helium lines in type *B* stars in which it was shown that the absorption which occurs between the known *d* and *f* lines could not be explained on the basis of laboratory experiments, Doppler effect, relative intensity changes in absorption as compared with emission, or collisional damping. Prof. J. A. Gray gave the analysis of the gamma-rays of radium D and radium E in which he showed that Ra E emits no primary γ-rays but 1·5 per cent of the disintegrating atoms emit a secondary γ-ray; which varies in energy from a few thousand volts to a million volts. Prof. J. Satterly gave the results of further investigations of the inclined water jet which definitely disprove Levi-Civita's original theory.

Among the papers communicated by Prof. E. F. Burton special interest was shown in a paper on the measurement of the velocity of sound in liquid helium at ultra-sonic frequency at temperatures ranging from 4·2° to 1·7° K. The velocity varied from 180 to 230 m./sec. over this range. In another paper, by H. E. Johns and J. O. Wilhelm, the refractive index of liquid helium I at 4·2° K. with λ 5461 was found to be $1{\cdot}0206 \pm 0{\cdot}0012$ and for He I at 2·26° K., $1{\cdot}0269 \pm 0{\cdot}0004$. Prof. A. L. Clark and L. Katz described a method of measuring the specific heats of gases by a modified form of the Assmann method. Prof. J. K. Robertson and R. H. Hay gave the results of experiments on the removal of wall deposits from tubes carrying high-frequency discharges and Dr. E. A. Hodgson indicated evidence of the variation in the thickness of the earth's crust from a study of earthquake records. Prof. L. Gilchrist and associates presented papers on applied geophysics, in which the use of drill holes for the central electrode method may be mentioned. Prof. D. A. Keys and H. G. L. Watson gave the results of experiments in the Slocan district of British Columbia using the Broughton-Edge radiometer method and a modification of this arrangement for locating conducting veins of galena.

Prof. W. H. Barnes of McGill, Dr. Ralph E. DeLury of Ottawa and Prof. J. A. McRae of Queen's were elected fellows in Section III.

Geology

In Section IV, embracing the geological sciences, twenty-three papers were presented. The presidential address by E. S. Moore was on "Some Problems of the Canadian Shield". Prof. Moore, among other things, discussed the Pre-Cambrian granites, the Couchiching problem, and the questions relating to life in the Pre-Cambrian. In another paper he reviewed the problem of the Steep Rock Series, and gave as his conclusion that at Steep Rock Lake, the Steep Rock and the Seine are the same series.

Four interesting papers were given on glaciology. J. T. Wilson described an area in south-western Nova Scotia in which some 2,300 drumlins occur. They can be identified and mapped from air photographs. They are related to slate bedrock and form the good agricultural land of the area. G. W. H. Norman described the last Pleistocene ice front in Chibougamau district, Quebec, and J. T. Wilson the moraines, beaches and large eskers in a neighbour-

ing region of the same province drained by the Harricanaw and Bell Rivers. The papers throw considerable new light on the late Pleistocene history of this region. R. L. Rutherford presented some aspects of glaciation in southern and central Alberta.

Six palæontological papers were presented. Alice E. Wilson gave an account of some gastropods from Akpatok Island, Hudson Strait, which had been collected by the Cambridge–Oxford expedition of 1931. They include twenty species, ten of which are new, and permit certain correlations with the Manitoba Red formation. F. H. McLearn gave an account of the Triassic faunas of the Peace River foothills, and R. T. D. Wickenden presented a paper prepared by F. H. McLearn and himself on some Cretaceous maps of the Canadian interior. E. M. Kindle described the Devonian succession at the eastern end of Gaspé peninsula, and made certain correlations with the Devonian succession as exposed in Matapedia valley. A paper by V. J. Okulitch on some Black River corals was read by title. J. A. Allan described some occurrences of Cambrian rocks in Sunwapta Valley, Jasper Park, Alberta, and L. S. Russell gave a description of the skull of Hemipsalodon Grandis, a giant Oligocene creodont, and showed illustrations of his restoration.

L. Gilchrist presented a theoretical study of a useful collection of equivalent magnets as an aid to the magnetic exploration of ore bodies. J. S. DeLury discussed his views regarding the significance of association of rock and ore.

M. Y. Williams presented a paper on submarine channels and orogenic movements along the coast of British Columbia. Deep channels extend across the continental shelf for a distance of at least 50 miles from the shore-line. The profile of these valleys suggests a downwarping of the coastal region and verifies the geological conclusions of the existence of a land mass, Cascadia, which is believed to have disappeared beneath the sea during the Miocene.

L. S. Russell presented his views concerning the origin of the sandstone dykes of south-eastern Alberta. An earlier theory that the material forming the dykes was forced up from below was not accepted. Russell believes that the dyke material was introduced from above or from the side during Tertiary times. J. A. Allan described how a relief model of the province of Alberta was prepared and told of its geological applications. He also gave a short paper describing a seiche at Yellowknife Bay on Great Slave Lake which occurred while he was there last summer.

A paper by N. B. Keevil was read describing the application of the helium method of age determination to granites. His determinations diminish considerably the commonly accepted figures for the length of geological times.

Biology and Medicine

Prof. V. E. Henderson's presidential address to Section V, entitled "The Search for a Perfect Anæsthetic", consisted of a review of the anæsthetic problem and a critical discussion as to the qualities and shortcomings of some of the more commonly used general anæsthetics, such as ether, chloroform and nitrous oxide. It will be recalled that as a result of work in Prof. Henderson's laboratory in 1930 cyclopropane was introduced and has received world-wide approval as a general anæsthetic possessing qualities which the older anæsthetics lack.

Frère Marie-Victorin of the University of Montreal discussed certain aspects of the relic flora of Canada, and submitted that earlier views concerning this flora must be modified somewhat, more importance being attached to post-glacial migrations of various kinds.

Mr. A. E. Porsild of the National Museum considered the flora of Little Diomede Island, Bering Strait, pointing out, as a matter of particular phyto-geographical interest, that a comparatively large number of circumpolar species, common to both sides of Bering Strait, do not occur on the island.

Dr. D. C. McPherson, University of Toronto, reported that air-space development in the root cortex of maize resembles that in certain water plants, in that cortical cells die and their walls collapse leaving the spaces; the death of the cells has proved to be due to inadequate oxygen supply.

Miss Helen Farley and Prof. A. H. Hutchinson, University of British Columbia, submitted an account of ovule development in certain alfalfa hybrids.

Prof. R. B. Thomson pointed out that, in the pollen cone of the yew, the radial stamen is derived from two stamens of the dorsi-ventral type. He also discussed the seed-cone scale structure of conifers, showing how the *Taxus* or one-sided line, and the pine or two-sided line, have evolved from the araucarian ancestral type.

Dr. J. Ansel Anderson of National Research Laboratories reported that the superiority in malting quality of O.A.C. 21 barley over Wisconsin 38 appears to be varietal in nature and independent of malting method.

Dr. R. Darnley Gibbs, of McGill University, described seasonal changes in the composition of white birch trees on the Island of Montreal. Sucrose is the main winter storage form of carbohydrates, and doubtless plays an important role in frost resistance.

Prof. E. M. Walker showed that the remarkable insect *Grylloblatta* has closer affinities with the *Saltatoria* than other Orthopteroid groups, despite certain primitive features suggestive of the Plecoptera.

A contribution from Prof. C. McLean Fraser, University of British Columbia, considered the distribution of the boreal hydroids, coming in from the polar region, as well as those indigenous, to the Pacific area adjacent to Canada and the United States, and of the tropical or subtropical species coming in from the south, or indigenous to this same area.

Dr. E. Horne Craigie reported an investigation of vascularization of the hypophysis in tailed amphibians, indicating a relation between folding and blood supply only by a superficial plexus.

Dr. R. C. Sniffen, Mr. H. L. Collins and Miss H. E. Williams have been engaged under the direction of Sir Frederick Banting upon researches relating to silicosis. Silicosis is caused by the inhalation of rock dust (siliceous dust) which leads to gradual destruction of the delicate tissue of the lungs, and is one of the gravest hazards which north Canadian miners have to face. The method of control which shows the greatest promise is one involving the mixing of aluminium dust with the air of the mine. Aluminium dust itself is innocuous, and experiments upon animals indicate that it actually neutralizes the poisonous action of the siliceous dust.

Three years ago, Dr. D. A. Scott of the Connaught Laboratories made the discovery that certain metals, zinc, cobalt, nickel, etc., are closely associated with the chemistry of insulin, and that in order to obtain

crystals of the hormone at least one of these metals must be present in the animal material (beef pancreas) from which the insulin is extracted. In a paper read at this year's meeting of the Society, Drs. Scott and Fisher reported on the preparation of nickel-insulin crystals; these were found to contain about 0·4 per cent of nickel. Dr. Scott's researches have an important practical bearing for it was soon found that zinc, like protamine (a protein material obtained from salmon sperm), prolongs the action of insulin. The improved product, protamine-zinc insulin, is now in general use for the treatment of diabetes. This preparation has the great advantage over the older ones in that, owing to its prolonged action, less frequent dosage is required to control the disease—a fact cordially welcomed by the diabetic patient.

An interesting series of experiments on coronary artery thrombosis was described in a paper by Dr. C. H. Best and Dr. D. Y. Solandt. Coronary thrombosis was produced in animals by the injection of a chemical (sodium ricinoleate) into the neighbourhood of one of the main arteries. The electrical changes in the heart during the period of survival and the microscopical appearance of the heart muscle after death were studied.

The researches of Dr. P. J. Moloney and his colleagues in the Connaught Laboratories, as reported in a paper entitled "The Detoxifying Action of Human Bile", reveal the fact that diphtheria toxin is innocuous after being treated with human bile.

Drs. W. R. Campbell and M. I. Hanna have found that the proportions of the different proteins in the plasma of all healthy persons are approximately the same, nor are they altered in most diseases. In some instances, however, they vary in such a way from that seen in health as to be of valuable assistance in recognizing certain diseases.

Dr. J. K. W. Willard, in the course of some experiments in British Columbia, accidentally injected some plant hormone into his hand. A tumour developed near the tiny wound. Fortunately it was an innocent growth.

Astronomy's Debt to Photography

THE Photographic Journal of April contains the thirty-third Traill Taylor Memorial Lecture entitled "Photography in the Exploration of the Universe" which was delivered by the Astronomer Royal, Dr. H. Spencer Jones, on October 19 last when he was presented with the Traill Taylor Memorial Medal of the Royal Photographic Society.

Dr. Spencer Jones began by describing the modern photographic method of determining the distances of the nearer stars. From a single plate taken with the Greenwich 26-inch refractor, giving a scale of $30'' = 1$ mm., the probable error of the position of a star whose parallax is being determined is about $0{\cdot}024''$ which is equivalent to about 0·0008 mm. The probable error produced by local distortions in the gelatin film does not usually exceed 0·0003 mm., a fact which shows how eminently suitable the photographic plate is for the measurement of minute parallactic displacements given by the changing viewpoint of the earth in its annual journey around the sun. The only visual method of parallax determination comparable in accuracy with photographic methods is that of the heliometer, which in the hands of Bessel one hundred years ago yielded with considerable accuracy one of the first three stellar parallaxes to be successfully determined. It is estimated, however, that the output of results by photographic methods is increased by a factor of 15, since the actual micrometric measures are made at any convenient time subsequent to the taking of the photograph.

At stellar distances equivalent to 400 light years, the trigonometrical method of measuring the distances of the stars breaks down, because the quantities to be measured become increasingly smaller than the probable errors of measurement, microscopic though the probable errors have been reduced to by the most scrupulous attention to every detail. For the determination of stellar distances beyond what is merely the fringe of near-by space, the astronomer makes use of the unique properties of the Cepheid variable stars, which are found not only in the star clusters of our own stellar system (some 120,000 light years in diameter) but are recognizable in the nearer and resolvable extra-galactic nebulæ whose unit of distance from us is a million light years. The discovery of the period-luminosity relation (which makes the Cepheids criteria of distance), announced by Miss Leavitt in 1912 and extended by Hertzsprung and Shapley, was made possible by a series of photographs of the Magellanic Clouds. The yet greater distances of the spiral nebulæ whose stellar structure is beyond resolution into individual stars can be determined by extrapolating the empirical relation found between distance and radial velocity, given by Doppler shifts, of the nearer systems. The photography of the spectra of these faint objects ranging up to 250 million light years away is a veritable *tour de force*. At the focus of the telescope their images are invisible, and the setting of the slit of the spectrograph has to be made in each case by means of a near-by star in the field of view whose angular distance from the nucleus of the nebula is obtainable from long-exposure direct photographs.

Honours in this triumph of observation have, of course, to be shared between the photographic plate, the giant telescopes employed, the special camera lens (such as the Rayton or the Bracey lens) and the ingenuity and patience of the astronomer. From statistical results of apparent magnitudes, it is deduced that the most distant systems that can be recorded on long-exposure direct photographs, on special emulsions of high-threshold sensitivity, taken with the 100-in. reflector at Mount Wilson, are at a distance of about 500 million light years. Within a sphere whose radius is equal to this limiting distance, it is estimated by Hubble from counts taken from photographs that there are about 100 million stellar systems—veritable universes that are units of the cosmos. A number of slides shown during the lecture and in part reproduced in the article, illustrate the perfection of results given by the photographic plate in recording the Milky Way, gaseous nebulæ, star clouds and individual star clusters, and the remote extra-galactic nebulæ.

Coal Carbonization in the Public Service

So many articles have appeared during recent years on the subject of coal carbonization and the problem is now so interconnected with political issues that one is apt to lose sight of the basic fact which should determine its technical and economic development.

Mr. E. V. Evans, in a lecture delivered at the Royal Society of Arts, on March 2, made the position abundantly clear. Coal and oil resources which are being exploited to-day took millions of years to accumulate. These resources are being used at an immeasurably greater rate than that at which they were formed and for this reason alone none of them should be wasted, no matter in what countries they are situated. It may be that in future years new types of liquid fuel will be produced from different raw materials to meet the ever-increasing demand for that commodity. At present, however, that consideration does not arise and the process of carbonization should be judged finally on its capability or otherwise of husbanding such natural resources of coal and oil as are known to exist to-day.

Carbonizing and electricity generating industries are each capable of contributing substantially towards conservation of natural resources. As a general rule, in the gas industry to-day the thermal energy of coal is distributed into coke, gas and tar in the proportions of 70 : 25 : 5 respectively. Actually 23 heat units of coke are used in the carbonizing process and therefore the thermal efficiency of the process is approximately 77. On the face of it, it would appear that coal has not been saved but the products obtained are more efficient in use, with the result that in the aggregate a greater thermal efficiency is achieved. Moreover, a certain amount of tar and sulphate of ammonia is obtained and a social benefit conferred by the elimination of atmospheric pollution.

The electrical industry has achieved striking results during recent years. In 1917, 3·7 lb. of coal was required to generate one unit of electricity, whereas to-day approximately 1·48 lb. of coal will do the same work. In addition, centralization of power generation has effected great economies. Nevertheless, there is still a tendency among consumers to regard electricity as a very convenient form of fuel and not as a means of transmitting mechanical power. In converting heat energy to mechanical energy approximately two thirds of the original heat energy of the coal is sacrificed. It is definitely uneconomic to use electrical energy for heating purposes. Actual figures can be adduced to show that the capital expended by the electricity companies is two and a half times as great per equivalent ton of raw coal as it is for the gas companies. Each of these industries provides an important public service and the most valuable contribution they can make is to collaborate with each other and be less competitive. There is a great field for expansion of the electrical industry in provision of mechanical power to save human effort, but provision of domestic heat should be the charge of the gas industry.

Special Steels in Marine Engineering

In response to an invitation to place before the members information concerning the modern special steels with the aim of simplifying their task in availing themselves of the latest metallurgical products, Dr. T. Swinden, director of research to the United Steel Companies, Ltd., delivered before the North East Coast Institution of Engineers and Shipbuilders, on February 25, a paper in which he surveyed the developments of recent years in this sphere. Although his remarks were in many instances more particularly pointed to their applications in hulls, marine boilers, superheaters and engines, his review of the chemical and physical properties of special steels, their amenability to heat treatment, their weldability and their resistance to corrosion and embrittlement were of even wider interest to the engineering profession.

Dealing first with the carbon and low-alloy steels, Dr. Swinden explained the present position as to their special characteristics and then proceeded to enumerate the properties of the more highly alloyed steels which are of increasing importance in engine construction. In addition to comprehensive data of an orthodox character, special attention was given to the subject of fatigue and notch sensitivity, and tables showing results of research on these were included among the many numerical data which the paper contains. From a series of tests on a variety of steels ranging from 20 to 70 tons tensile, it was shown that while the fatigue limit on plain specimens is related approximately to the maximum stress, the notch sensitivity is related roughly to the ductility as measured by elongation. Surface hardening in its various aspects was treated in some detail, the several methods of case carburizing, cyanide hardening, the Shorter process, the Tocco surface hardening process and the nitriding process being discussed and their most favourable applications indicated. Dr. Swinden also dealt with the properties of steels made for use at elevated temperatures, and introduced a discussion on creep and creep strength. As a reliable value on which to base design, he commented on the safe working stress indicated by the stress relaxation method of testing for creep.

Finally, after some notes on stainless steel, Dr. Swinden discussed the possibilities of a stainless-faced composite material which consists of mild steel with a facing of about 20 per cent stainless steel. The method of production admits of the combination of plate material with any variety of stainless steel, resulting in a perfect union between the two metals. This material is extensively used in the United States and, as the author stated, one can readily visualize many purposes in shipbuilding and marine engineering where it could be used with advantage and with definite economy as compared with solid stainless steel.

Scientific Research and Social Well-being

IN his University Research Lecture, 1935–36, delivered at the University of Colorado, O. C. Lester, discussing the development and present status of graduate study and research in the University of Colorado, emphasized the importance of the spirit which animated the Graduate School and the attitude of the faculty to original creative work. The University of Colorado Studies was started chiefly as a medium for the publication of original work by members of the faculty and has been the chief medium of exchange with other universities, and gives important encouragement to creative work by affording a medium for publication.

Another obligation of the university to society is to maintain the supply of trained investigators, and the University's research fellowships and scholarships are designed to assist in discharging this obligation. It is not easy to evaluate the contributions of the faculty to research or other forms of creative scholarship, but the increasing demand for advanced work has led to the appointment of a Council of Research, one of the recommendations of which has led to the inauguration of an annual research lecture, of which Mr. Lester's is the first.

In the remainder of his lecture, Mr. Lester discussed the relation of research, the university and the social order, and particularly the question whether scientific research workers should not modify their traditional attitude of being concerned only with discovery and not with its results to society or with the social consequences of scientific progress in general. The purpose of research is the betterment of human life, and on the whole that has been its effect. Apart from the comforts and conveniences beyond the reach of the rich a hundred years ago which are now possible for the average person, research has led to the eradication or alleviation of many ills of the body. Better understanding of the many factors affecting the health and vigour of both body and mind has led to the development of preventive measures which are becoming more and more effective. Reviewing briefly the organization and support of research, he stressed the supreme importance of the university in fundamental research, both as affording the right opportunity and atmosphere and in maintaining an adequate supply of investigators. The problems of modern civilization are too numerous, too varied, too complex to be solved by a few men, however capable, and the number of research workers, their technical training and the resources at their command required increasing in proportion.

Mr. Lester does not agree that we should be better off if much of our modern science and the appliances growing out of it were scrapped. If scientific advances have disturbed and continue to disturb the economic *status quo*, the remedy lies rather in attaining comparable and co-ordinating progress in the general field of the social sciences. Failure of progress here is indeed largely due to the inability of those who have reached well-founded conclusions to get a hearing, or even to unreasoning opposition to change. We need research on how to use the results of research for the general good, and in such work universities are well qualified to take a leading part. Not merely the general good but also scientific and industrial progress depend on a better social balance. Patchwork emergency methods and methods of political expediency are wholly inadequate for solving complex social problems and must be abandoned for thoughtful planning based upon thorough investigation.

Some French Industrial Laboratories

THE University of Algiers has a small, but well-equipped, industrial testing laboratory under the direction of Prof. L. Vérain, professor of physics in the University. In a lecture entitled "Les Laboratoires industriels", delivered by Prof. Vérain, it is recorded that in 1935, some eight hundred certificates were issued by the Laboratory, the fees received being 56,000 francs.

The Laboratory's interests are many sided: electrical standards, electrotechnics and photometry; a wind tunnel; hydraulics; heat engines and refrigeration plants; the testing of wood, metal, cements, concretes, plasters and road materials; thermal conductivity; acoustic insulation; absolute pressure; viscosity; and X-rays. In connexion with the testing of accelerometers, it is remarked that in Germany a car which cannot decelerate at not less than four metres per sec. per sec. is the subject of penalties if used after warning.

In his lecture, Prof. Vérain remarks that industrial laboratories date from the latter part of last century, when scientific methods were introduced into industry, and he traces their utility in the various stages of development of a process, or in the manufacture of a material or other product. Large works, especially chemical, metallurgical or engineering, commonly have their own laboratories.

In France, the first industrial laboratory was that of the École Nationale des Ponts et Chaussées, the chemical laboratory of which was opened in 1831. The city of Paris set up an engineering laboratory in 1869, and its specifications are still accepted by other organizations. The Laboratoire d'Essais du Conservatoire National des Arts et Métiers, founded in 1900, has five departments, but is not concerned with electrical measurements, for which a laboratory was founded in 1888, under the direction of the late M. Janet. This latter includes a radio laboratory, an engineering testing laboratory, and a co-ordinating office. The French Standards Association (AFNor) has issued some 800–1,000 standards, which may be contrasted with the 5,000 prepared by the corresponding German association.

British Association at Newcastle-on-Tyne in 1838

ON Saturday, August 18, 1838, a meeting of the General Committee of the British Association was held at Newcastle-upon-Tyne preliminary to the formal proceedings of the Association, which began the following Monday and lasted the whole week. Eighty members of the committee were present, and owing to the Earl of Burlington being absent on the Continent the chair was taken by Prof. Whewell. Among other matters it was recommended that collectors should be appointed in places where the meetings of the Association were in future held, and that they should be allowed a percentage of the subscriptions they received.

The deaths of Prof. Moll, of Utrecht, and Dr. Bowditch, of Boston, U.S.A., were announced, and it was stated that the Council had elected Prof. Dumas and Prof. Liebig foreign members. The report touched on the difficulty experienced in finding a qualified person to report on the effects of voltaic and thermal electricity, the question of international copyright, astronomical observations at Madras, and tidal observations, and also the laws regulating the constitution of the General Committee. A discussion took place on the last matter, and it was proposed that the committee should consist of: (1) the officers of the Association past and present and authors of papers prepared by direction of the Association; (2) members who had contributed a paper to a philosophical society on a subject taken into consideration of the Association; (3) delegates from philosophical societies publishing transactions; (4) delegates from philosophical societies in towns in which the Association met; and (5) foreign and other distinguished individuals whose presence might be deemed advisable.

As was its usual custom, the *Athenæum* devoted much space to the doings of the Association, and in referring to the industrial establishments in the district it spoke of the collieries, ironworks, glass, soap, and colour manufactories, the locomotive works of Robert Stephenson and Co., and those of R. and W. Hawthorn, where members would be able to see a Harrison patent locomotive with 10 ft. driving wheels. Special reference was made to the bridge or viaduct on the Shields Railway, at Ouseburn, which was "of immense magnitude as regards both length and height". At Walker were to be seen the alkali works of Losh, Wilson and Bell, which deserved the attention of the chemist not only on account of their completeness but also because the head of the firm, Mr. William Losh, was "the father of soda-making on the Tyne". There were 250 tons of crystallized soda made per week, besides 100 tons of alkali or soda ash.

According to the *Athenæum*, the general arrangements for the meetings were excellent and nothing had been neglected to ensure a pleasant, a brilliant and a profitable meeting. "The commonalty, however, arguing from these expensive preliminaries, seem to have anticipated a Congress of Princes, or an aggregation of *millionaires*, and in many instances to have increased the rent of their lodgings at least five hundred per cent." Though such attempts were frustrated by the local members, this recurrence should be guarded against in the future, "the limited incomes of scientific men, generally not admitting of these extravagances".

Societies and Academies

Edinburgh

Royal Society, July 4.

JAMES GREGORY TERCENTENARY CELEBRATION. Prof. H. W. Turnbull: James Gregory, and his Unpublished Discoveries. Prof. F. Enriques: Piccole note su James Gregory e il suo soggiorno in Italia. Profs. M. Dehn and E. Hellinger: On James Gregory's "Vera Quadratura". Dr. Adolf Prag: On James Gregory's "Geometriæ Pars Universalis".

Ordinary Meeting on July 4.

C. VANEY: Note sur les Crinoïdes de la *Scotia*. The collection is a small one, and only a part is here described. Species mentioned are: *Isometra vivipara* Mortensen (Burwood Bank); *Ilycrinus australis* Clark (lat. 62° 10′ S., 41° 20′ W. in 1,775 fathoms); and a new species, *Ptilocrinus brucei*, described from two specimens (lat. 64° 48′ S., 44° 26′ W. in 2,485 fathoms, and lat. 52° 10′ S., 41° 20′ W. in 1,775 fathoms).

H. D. SLACK: The association of non-homologous chromosomes in Corixidæ (Hemiptera-Heteroptera). The examination of twenty species of aquatic bugs of the family Corixidæ has revealed an unusual type of association of chromosomes during spermatogenesis in three species. This consists of the fusion of terminal or sub-terminal regions of chromosomes which are not homologous pairs. It is first seen at early meiotic prophase and lasts until repulsion forces separate the bivalents at diakinesis, the heterochromatic material uniting the chromosomes being drawn out into fine threads which eventually break. Owing to this association of non-homologous chromosomes, relational coiling of homologues appears to be partially interrupted, but in other respects the course of meiosis remains unaffected.

L. C. COMRIE and ANN B. ADAM: The female reproductive system and corpora lutea of the False killer whale, *Pseudorca crassidens* Owen. From specimens stranded in the Tay Estuary, 1935, a description is given of the female reproductive system of fœtal, immature and mature animals. Particular reference is made to the corpora lutea, and from their numbers and condition it is tentatively suggested that the age-range of the specimens is 2–20 years.

N. GALPIN: Factors affecting postnatal growth of brown Leghorn chickens. The postnatal growth of brown Leghorn chickens is influenced both by the season of the year at which the eggs are laid, and by the individuality of the parent birds. The seasonal variation shows the same trend as do those of hatching weight and of maternal thyroid weight.

J. P. CHU: Studies on plumage in the male brown Leghorn fowl. A detailed investigation of feathering order, and of changes in feather pattern and structure between hatching and maturity, in the male brown Leghorn fowl. Experimental data indicate that the changes in plumage type are largely dependent on variations in the level of thyroid activity.

D. M. S. WATSON: On *Rhamphodopsis*, a Ptyctodont from the Middle Old Red Sandstone of Scotland: The paper gives a relatively full account of the structure of the whole skeleton of a small Ptyctodont, which shows that the group contains essentially normal Arthrodeiss, peculiar in the reduction of the body armour. Two types of pelvic fin occur, presumably in the two sexes of a single species.

W. P. KENNEDY: Seasonal trends of births in Scotland. The seasonal incidence of conceptions in Scotland was examined for the period 1880–1935, and a regular seasonal variation was found from year to year, the peak of the curve falling in summer, the trough in winter. On correlating the mean daily conceptions per month with the mean temperature of the month, a positive correlation coefficient of 0·671 was found. When the period is split into decades, the individual correlations do not differ significantly from each other, and indeed are remarkably consistent. It is considered that there is a real relationship between temperature and the conception rate. The higher the mean monthly temperature in Scotland, the greater the chances of conception. The average range of seasonal difference from the mean of the year is ± 9 per cent.

Paris

Academy of Sciences, June 20 (*C.R.*, 206, 1841–1932).

HENRI DESLANDRES: The universal constant of band spectra. Attribution of the lines of the band to causes other than the rotation of the molecule.

ALEXANDRE GUILLIERMOND and ROGER GAUTHERET: The action of Nile blue and cresyl blue on yeasts. The reduction and excretion of these colouring matters by yeasts.

FRANÇOIS GRANDJEAN: Suppression of organs in the evolution of a homeotype series.

ROBERT ESNAULT PELTERIE: The yield of thermal machines.

CHARLES PISOT: Some rational approximations characteristic of algebraic numbers.

HENRI LAUGIER and MLLE. DAGMARE WEINBERG: An attempt at the factorial analysis of marks in examinations for degrees. Relations between the marks of the different written tests.

BERNARD D'ORGEVAL: A construction of multiple planes representative of algebraical surfaces of genera 1.

ROBERT POTIER: Abstract spaces with affine connexion.

FRÉDÉRIC ROGER: Certain types of ensembles of zero magnitude.

AYZYK GORNY: Indefinitely derivable functions.

NIKOLA OBRECHKOFF: Integral functions limits of polynomials the zeros of which are real and interlaced.

EDMOND BRUN: The measurement of the pressures on a body in rotation in air.

LOUIS VIAUD: The study in a wind tunnel of the aerodynamical characteristics of some supporting arrangements placed near the soil.

LOUIS GOLDSTEIN: The mechanism of activation of atomic nuclei.

VICTOR NAGGIAR: A new method of measuring the surface tension of liquids.

ANDRÉ RASKIN: The realization of a high-tension generator with large yield.

NICOLAS BEZSSONOFF and MME. MÉLANIE WOLOSZYN: The oxidation-reduction potential developed by solutions of vitamin C in the presence of oxygen.

ERNEST BAUMGARDT: The velocity of propagation of elastic waves in piezo-electric crystals.

JEAN PAUL MATHIEU: The optical properties of stratified cholesteric substances.

PIERRE BARCHEWITZ and MAURICE PARODI: A spectrometer with a wire grating for the study of the extreme infra-red. The apparatus described serves to study the spectral region 20 μ–100 μ, with an accuracy of about 1 μ.

MME. ARLETTE VASSY and ETIENNE VASSY: An experimental method for the comparison of the absorption of light by the lower atmosphere and by the total atmosphere.

MLLE. SUZANNE VEIL: Some circumstances relating to the co-precipitation of silver bromide and chromate.

MME. LÉONE WALTER-LÉVY: Contribution to the study of the magnesium halogen carbonates.

LÉON JACQUÉ: The action of hydrogen on the carbides of iron and chromium. The iron carbide, Fe_3C, loses carbon when heated in hydrogen. At a temperature of 550° C., and under a pressure of 100 kgm./cm.², the whole of the carbon is removed in 50 hours. The chromium carbides, Cr_3C_2, Cr_7C_3 and Cr_3C_2, treated with hydrogen under the same conditions, show no appreciable loss of carbon.

MLLE. MARIE CÉCILE BAILLY: A simple and almost quantitative method for passing from the β- to the α-glycerophosphates. On boiling a solution of the β-salt with dilute sulphuric acid (4 per cent) over 90 per cent is converted into the α-salt.

YVES VOLMAR and ERNEST WEIL: The action of antimony trisulphide on the acid alcohols.

ANDRÉ DEMAY: The granites, microgranites and rhyolites from the eastern extremity of the massif of Guéret, and particularly on the existence of tourmaline in certain rhyolites.

ROBERT LAFFITTE: The presence of Operculines in the formation known as pisolithic limestone in the Paris basin.

JEAN PIERRE ROTHÉ: The Belgian earthquake of June 11, 1938.

HENRI GRISOLLET: Study of the light diffused by particles in suspension in the air.

GABRIEL LUCAS: The *Cancellophycus* of the Jurassic are Alcyonaria.

ROBERT HOFFSTETTER: The presence of Elapidæ represented by a new genus in the French Neogene.

JEAN RENAUD: The division of the nucleus of yeasts in the course of budding evidence of a centrosome and of mitosis.

ROGER HEIM: The stelliform cells of the Aphyllophorales.

PIERRE CHOUARD: The formation of absorbent skins on the epidermis of the leaves of *Begonia Rex* in relation with the application of hetero-auxines.

G. JEANNENEY and G. RINGENBACH: The density of the blood and transfusional shock.

EMILE BRUMPT and ACHILLE URBAIN: A curious verminous disease with Acanthocephalæ, endemic in the monkey house of the Museum. Efficacious prophylactic measures taken with a view of arresting the disease.

A. DONATIEN and F. LESTOQUARD: The evolutionary of some *Rickettsia*.

Amsterdam

Royal Netherlands Academy (*Proc.*, 41, No. 6; 1938).

F. A. VENING MEINESZ: Second order disturbance terms (Browne terms) in pendulum observations at sea. A further experimental determination of these terms with the aid of apparatus installed in a submarine.

A. DE KLEYN: Some remarks on vestibular nystagmus.

J. G. VAN DER CORPUT: Contribution to the additive theory of numbers (4).

J. A. SCHOUTEN: The relations between the geometrical quantities in an X_n and in an X_m embedded in the X_n.

J. A. SCHOUTEN and J. HAANTJES: The differential geometry of groups of contact transformations (4). Covariant derivatives in the K_{2n-1}.

A. A. NIJLAND: Mean light curves of long period variables. (31) γ Cassiopeiæ. The period of this star is 417·8 days and the amplitude is 4·29 magnitudes. (32) R. V. Pegasi. Period 388·0 days, amplitude 4·96 magnitudes. (33) R. Z. Pegasi. Period 437·1 days, amplitude 4·33 magnitudes.

W. A. MIJSBERG: Peaks occurring in frequency curves of the cephalic index and their supposed significance in indicating the component races and subracial groups underlying the population. (1) Exposition of the problem.

G. C. E. BURGER and H. C. BURGER: Determination of the rate of infection in tuberculosis.

C. S. MEYER: Contributions to the theory of Whittaker functions.

K. MAHLER: A theorem on inhomogeneous Diophantine inequalities.

P. G. MOLENAAR: Differential covariants of the first order of the binary cubic differential form.

H. G. BUNGENBERG DE JONG: Behaviour of microscopic bodies consisting of biocolloid systems and suspended in an aqueous medium. (1) Pulsating vacuoles in coacervate drops. (2) Formation of doubly-refractive 'membranes' on gelatin gel globules by tannin.

ANNIE M. HARTSEMA and IDA LUYTEN: Early flowering of the narcissus *N. pseudo-narcissus* var. King Alfred.

L. J. J. POP: Protoplasmic streaming in relation to spiral growth of *Phycomyces*.

H. KNIPSCHEER: On Cretaceous Nerineas from Cuba.

A. DE BUCK: The exochorion of the *Stegomyia* egg.

J. LUBBERS: Direct endophotography.

Washington, D.C.

National Academy of Sciences (*Proc.*, **24**, 229–251, June 15, 1938.)

W. J. ROBBINS and F. KAVANAGH: Evidence for a second thiamin.

D. L. FOX and C. R. MOE: An astacene-like carotenoid from a Pacific coast anemone, *Epiactis prolifera*. This orange-red anemone owes its striking colour to a red acidic carotenoid, present entirely in esterified form, and apparently similar to acid carotenoids found in other anemones by Heilbron *et al.*

BERTA SCHARRER and E. HADORN: Structure of the ring-gland (corpus allatum) in normal and lethal larvæ of *Drosophila melanogaster*. During development, growth of the ring-gland takes place by increase of size of cells; in 'lethal' larvæ, both gland and cells are smaller than in normal. Hence retardation of puparium formation in 'lethals' may be due to under-development of the ring-gland.

R. BRAUER: Normal division algebras of index 5.

H. BATEMAN: Lift and drag functions for an elastic fluid in two dimensional irrotational flow.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (CAMBRIDGE MEETING.)

Wednesday, August 17.

At 8.30 p.m.—The Rt. Hon. Lord Rayleigh, F.R.S.: Part I: "Vision in Nature and Vision aided by Science" (Presidential Address in the Regal Cinema). Part II: "Science and Warfare."

Thursday, August 18.

At 10 a.m.—Prof. N. Bohr, For. Mem. R.S., Dr. J. D. Cockcroft, F.R.S., Prof. W. Bothe, Dr. P. I. Dee, Dr. N. Feather: "Nuclear Physics" (Symposium: Section A).

Prof. C. S. Gibson, F.R.S.: "Recent Advances in the Chemistry of Gold" (Presidential Address: Section B, with an introduction by Sir William Pope).

Dr. S. W. Kemp, F.R.S.: "Oceanography and the Fluctuation in the Abundance of Marine Animals" (Presidential Address: Section D).

Prof. Griffith Taylor: "Correlations and Culture: a Study in Technique" (Presidential Address: Section E). Prof. R. V. Southwell, F.R.S.: "The Changing Outlook of Engineering Science" (Presidential Address: Section G).

Prof. F. Wood-Jones, F.R.S., D. F. Thomson, Prof. A. R. Radcliffe-Brown: "Australia" (Symposium: Section H).

Prof. W. Stiles, F.R.S.: "The General Physiology of the Plant Cell, and its Importance for Pure and Applied Botany" (Presidential Address: Section K).

Sir Richard Gregory, Bt., F.R.S. and H. G. Wells: Report of the Committee on the Content of School Curricula.

C. S. Orwin, Prof. J. A. Scott Watson, S. J. Wright, Dr. F. Kidd: "Agriculture in Relation to National Employment" (Discussion: Section M).

S. E. Urwin and W. G. Newton, D. Clarke-Hall, W. D. Seymour: "Tendencies in the Design of Schools" (Discussion: Section L).

At 11.10 a.m.—Prof. R. A. Fisher, F.R.S., Dr. C. C. Craig, H. W. Norton, Dr. W. J. Youden, F. Yates, W. L. Stevens: "Combinatorial Mathematics in the Design of Experiments" (Symposium: Section A*).

At 11.15 a.m.—Dr. F. G. Mann, Prof. L. O. Brockway, Prof. N. V. Sidgwick, F.R.S.: "Recent Advances in the Organic Chemistry of the Metals, with Special Reference to the Noble Metals" (Discussion: Section B).

Dr. H. Godwin, Dr. W. A. Macfadyen, H. L. P. Jolly, Dr. J. G. D. Clark, C. W. Phillips and Prof. H. H. Swinnerton: "The Post-Glacial History of the Fenlands" (Joint Discussion: Sections C and K).

D. W. Young, A. P. Long, A. L. Felton, J. Macdonald, A. H. Popert, W. H. Guillebaud: "The Cultivation of British Hardwoods" (Symposium: Section K*).

At 11.30 a.m.—Prof. A. G. Ogilvie, Prof. H. J. Fleure, F.R.S., J. McFarlane, Prof. C. B. Fawcett, R. H. Kinvig: "The Scientific Delegation to India, 1937–38; Geographical Impressions" (Section E).

At 5.15 p.m.—Prof. C. S. Gibson, F.R.S., Dr. F. G. Mann, H. V. Thompson and Dr. F. H. Brain: Demonstration in Section B lecture room on the production of gold films by chemical methods.

Friday, August 19.

At 10 a.m.—Dr. J. J. Fox, Prof. W. Gerlach, Prof. F. Feigl, Dr. Janet Matthews, Dr. K. K. Nygaard and Dr. Th. Guthe: "Modern Methods of Chemical Analysis" (Symposium: Section B).

Dr. C. G. Darwin, F.R.S.: "Logic and Probability in Physics" (Presidential Address: Section A).

Dr. C. J. Stubblefield, Dr. G. L. Elles, Dr. W. K. Spencer, F.R.S., Dr. A. Lamont: "The Distribution and Migration of Certain Animal Groups in the British Lower Palæozoic Fauna" (Discussion: Section C).

Prof. D. M. S. Watson, F.R.S., Dr. P. D. F. Murray, Dr. J. S. Huxley, Prof. R. A. Fisher, Prof. A. E. Trueman, J. Z. Young, Capt. C. Diver: "The Mechanism of Evolution" (Joint Discussion: Sections D and K). R. F. Harrod: "Scope and Methods of Economics" (Presidential Address: Section F).

A. T. Marston, Prof. W. B. R. King, M. A. C. Hinton, F.R.S., C. F. C. Hawkes, Sir Arthur Keith, F.R.S., Prof. W. E. Le Gros Clark, F.R.S.: "The Swanscombe Find" (Symposium: Section H).

Dr. R. H. Thouless: "Eye and Brain as Factors in Visual Perception" (Presidential Address: Section J). J. Sargent: "The Proper Function of Administration in Public Education" (Section L: Presidential Address). Prof. F. G. Stapledon: "Ley Farming and a Long-term Agricultural Policy" (Presidential Address: Section M).

At 11 a.m.—W. H. Robinson, Ruth Dawson, Dr. P. T. Freeman, Muriel Davies: "Education for a Changing Society: Senior and Secondary Schools" (Discussion: Section L).

At 11.15 a.m.—Prof. E. T. Whittaker, F.R.S., Dr. W. G. Bickley, Dr. J. C. P. Miller, Dr. A. J. Thompson: "From Function to Printed Table: Some Aspects of the Work of Preparing a Table of a Mathematical Function" (Section A*).

At 11.20 a.m.—Prof. W. L. Bragg, F.R.S., Dr. E. C. Stoner, F.R.S., Dr. A. J. Bradley, Dr. W. Sucksmith, D. A. Oliver: "Magnetic Alloys and X-Ray Structure" (Symposium: Section A).

At 2 p.m.—M. C. Burkitt, Sir Arthur Keith, F.R.S., Dr. F. E. Zeuner, Miss D. A. E. Garrod, A. L. Armstrong, Dr. K. P. Oakley, T. T. Paterson: "The Middle Palæolithic" (Symposium: Section H).

At 2.15 p.m.—Prof. F. T. Brooks, F.R.S., Dr. E. B. Worthington, Dr. W. B. Turrill, Dr. W. H. Thorpe, Dr. C. D. Darlington, Dr. D. G. Catchside: "The Mechanism of Evolution" (Joint Discussion, continued: Sections D and K).
The Right Hon. The Earl of Onslow: "The Importance of National Parks in the Preservation of the Flora and the Fauna of Great Britain" (Presidential Address to the Conference of Delegates of Corresponding Societies).

At 8.30 p.m.—Dr. H. Godwin: "History of the Fens" (Evening Discourse).

Saturday, August 20.

At 10 a.m.—Prof. P. M. S. Blackett, F.R.S., Prof. W. H. Furry, Prof. E. Regener: "High-Altitude Cosmic Radiation" (Symposium: Section A).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ESTABLISHED CIVIL ENGINEERING ASSISTANTS in the Roads Department, Ministry of Transport—The Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (August 15).

METEOROLOGICAL OFFICER CADETS in the Eire Department of Industry and Commerce—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (August 16).

TECHNICAL OFFICER in the Chemical Defence Experimental Station, Porton, near Salisbury—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (August 17).

ASSISTANT (grade III, mathematics or physics) in the Aeroplane and Armament Experimental Establishment, Martlesham Heath, Suffolk—The Under-Secretary of State, Air Ministry (S.2.D.), Adastral House, Kingsway, London, W.C.2 (August 19).

ASSISTANT (grade II) in the Air Ministry headquarters—The Under-Secretary of State, Air Ministry (S.2.D.), Adastral House, Kingsway, London, W.C.2 (August 19).

LECTURER IN CHEMISTRY AND LECTURER IN ENGINEERING in the Hull Municipal Technical College—The Director of Education, Guildhall, Hull (August 20).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Bradford Technical College—The Principal (August 20).

LECTURER IN PRACTICAL MATHEMATICS AND PHYSICS in the Heanor Mining and Technical School—The Clerk to the Governors, 30 Mansfield Road, Heanor (August 22).

LECTURER IN CHEMISTRY in the Denbighshire Technical Institute, Wrexham—The Director of Education, Education Offices, Ruthin (August 24).

TWO OFFICIALS (one in African agriculture and one in South American agriculture) in the International Institute of Agriculture, Rome—The Secretary (September 15).

LECTURER IN ELECTRICAL ENGINEERING in the Royal Technical College, Salford—The Director of Education, Education Office, Salford, 3.

Reports and other Publications

(not included in the monthly Books Supplement)

Other Countries

Allahabad University Studies. Vol. 13: Arts and Sciences. Pp. iv+256+90+8 plates. 7.8 rupees. Vol. 14: Arts and Sciences. Pp. v+249+174+11 plates. 7.8 rupees. (Allahabad: The University.) [147

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